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A new form of Sagitta bedoti Beraneck found in the littoral waters near Penang

By T. TOKIOKA
Seto Marine Biological Laboratory, Sirahama, Japan
and D. PATHANSALI
Fisheries Laboratory, Glugor, Penang

(*Received, June 1963*)

INTRODUCTION

SIXTY SMALL SPECIMENS of a chaetognath less than 8.5 mm. in body length were collected at three stations near Penang very close inshore, depth 6 to 8 metres, and in waters of low salinity of between 23.0 and 27.0 parts per thousand. Forty-three specimens were examined closely by the junior author, while the other seventeen specimens were sent to and examined by the senior author in Japan. These are now believed to be a form of *S. bedoti* Beraneck which is as yet undescribed.

DESCRIPTION

Sagitta bedoti forma **littoralis** nov. Figure 1.

The maximum size of the specimens obtained lay in the range 8.0–8.5 mm. total length with tail fin. The body looks rather transparent in larger individuals, but somewhat opaque in the smaller. The trunk is widest in the middle third and narrows gradually towards the anterior, and just before the juncture between trunk and head there is a slight constriction. There is an insignificant constriction at the tail septum as it passes into the tail segment. The anterior fin begins on the ventral ganglion near its posterior end, is widest posteriorly and narrows gradually anteriorly. It is as wide as the posterior fin and with a narrow rayless zone along the base in the anterior half. The posterior fin begins 3 to 5 per cent of total length with tail fin, from the posterior end of the anterior fin, is widest below the tail septum with 43 to 46 per cent of the fin above it. A narrow rayless zone is found around the seminal receptacle. The tail fin is rather high. The fully mature seminal vesicle was observed only on one specimen, 7.4 mm. in total length with tail fin; it is elongate, slender, with a slight thickening of the vesicle wall near the anterolateral corner. It is in contact with both posterior and anterior tail fins. The ovary is short and does not reach the anterior end of the posterior fin. The collarette is short, stretching behind the neck for a distance equivalent to the head length, and varies from fairly wide to wide. The corona ciliata is long, slightly sinous, begins above the eyes and extends about two-thirds the distance between neck (juncture of head and trunk) and ventral ganglion. Usually five large sensory patches are found along each lateral side of the corona. The outline of eye-pigment is roundish and rather small, and the distance between the eyes is comparatively large, being approximately one third the breadth of the head at that level. Intestinal diverticula are absent. Hooks usually 8–9, but may be 7 in larger individuals. Anterior teeth up to 10 and posterior teeth up to 21 in larger individuals. Rows of anterior teeth meet each other at an acute angle.

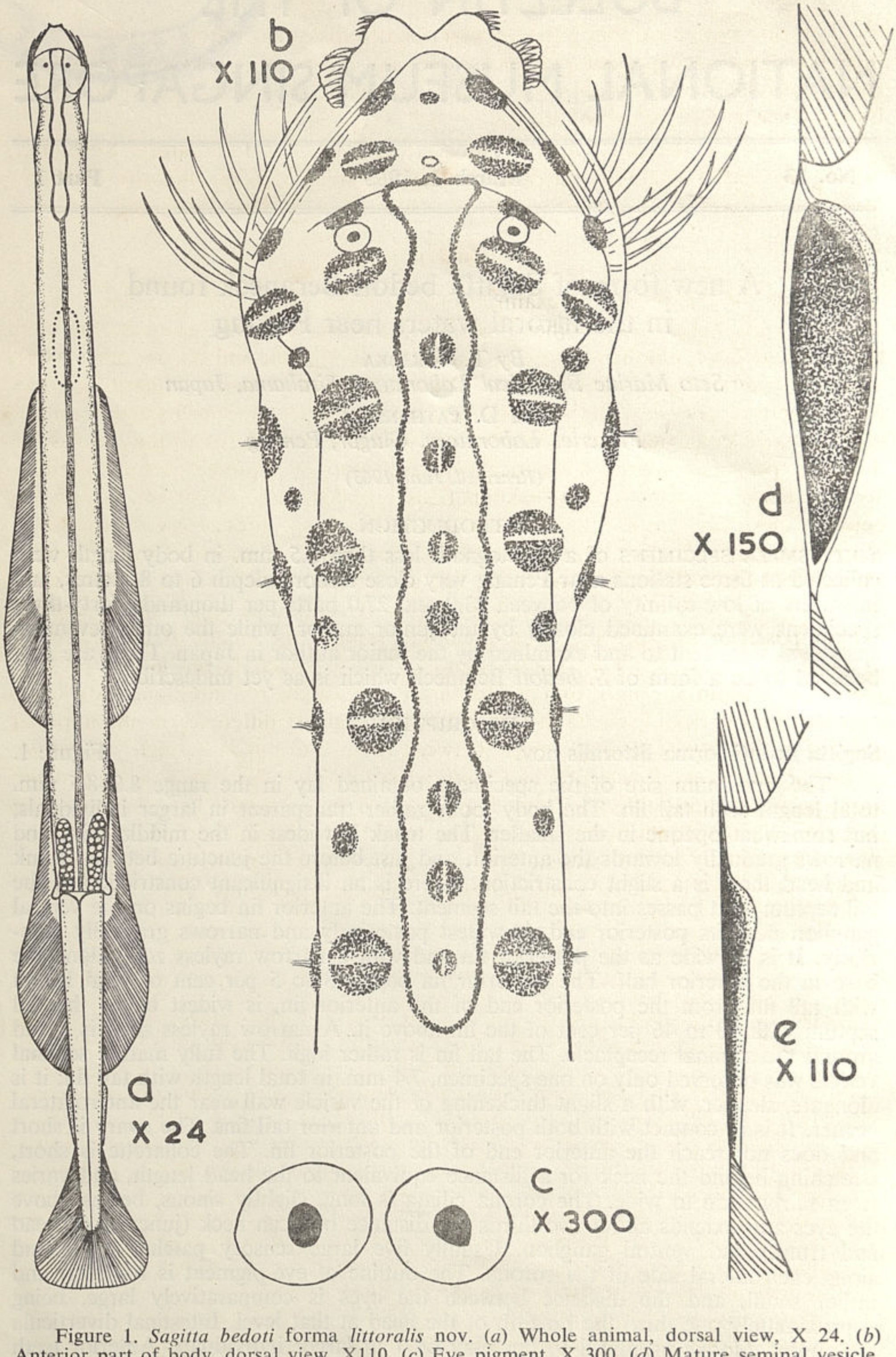

Figure 1. *Sagitta bedoti* forma *littoralis* nov. (*a*) Whole animal, dorsal view, X 24. (*b*) Anterior part of body, dorsal view, X110. (*c*) Eye pigment, X 300. (*d*) Mature seminal vesicle, dorsal view, X 150. (*e*) Immature seminal vesicle, dorsal view, X110.

It is not impossible that *S. tenuis* described from Indian waters by John (1933) is identical with the present specimens, and any comparison between the present specimens and *S. bedoti* reported from the highly protected waters along the Indian coast is left for future studies.

Syntypes are deposited in the Seto Marine Biological Laboratory, Sirahama, Japan, the Fisheries Laboratories at Glugor, Penang, Malaya, and the National Museum, Singapore.

DISCUSSION

Results of the respective examinations made by the authors (Tables 1 & 2) conform very well to each other, and the armature formulae given in the two tables resemble on one hand those of *Sagitta tenuis* Conant and on the other hand those of *Sagitta bedoti* forma *minor* Tokioka. The superficial similarity of the general body appearance and structure between the present specimens and *S. tenuis* and the exact coincidence of their armature formulae first led us to the conclusion that the specimens might be identical with *S. tenuis* or represent a form of that species. However, more crucial examinations revealed some important differences between these two. Unlike *S. tenuis* the anterior fin in the present specimens is not shorter than the posterior fin, but is as long as or slightly longer than the posterior. Moreover, both anterior and posterior fins are provided each with a rayless zone that has never been observed in *S. tenuis*. The TC-value (the length of the frontal half of posterior fin anterior to the trunk-tail septum/the length of the rear half of posterior fin posterior to the septum × 100) is much larger in the present specimens than in *S. tenuis,* excepting a single case of the 6.7 mm. long individual with mature ovaries (Table 2). There is not the slightest difference in the appearance of the immature seminal vesicle between these two, but in a single individual of the present specimens which had matured seminal vesicles, the vesicles assume an appearance quite different from that possessed by *S. tenuis*. In a similar stage of maturity, the vesicle of *S. tenuis* has a distinct "head" portion very easily discernible, while in the present specimens any "head" portion is not formed clearly, although there is a insignificant glandular thickening near the antero-lateral corner.

TABLE 1

The data on 43 specimens. Figures within brackets denote the number of species not measured for anterior and posterior fin lengths. Lengths expressed as percentage of total length with fin.

No. of Specimens	Total length in mm.	Tail length %	Anterior fin %	Posterior fin %	Hooks	Anterior teeth	Posterior teeth
6 (3)	4.0–4.5	28–31	24–25	23–25	8–9	4–5	7–10
1	4.5–5.0	29	27	24	8–8	5–5	10–10
(3)	5.0–5.5	27–29	—	—	8–9	5–6	10–12
6 (3)	5.5–6.0	28–30	26–27	24–25	8–9	5–6	10–12
7 (3)	6.0–6.5	28–29	25–27	24–26	8–9	6–8	11–16
7 (3)	6.5–7.0	27–31	26–28	23–25	8–9	5–8	12–15
5 (1)	7.0–7.5	28–31	27–28	24–26	8–8	7–10	14–19
4 (1)	7.5–8.0	29–30	26–27	24–25	8–8	7–10	15–18
4	8.0–8.5	28–31	26–28	24–25	7–8	8–9	17–21

TABLE 2

The data on 17 specimens

Body length in mm.	Tail length as %	Hooks	Anterior teeth	Posterior teeth	TC-value	Ovary	Seminal vesicle
4.0	31.2	8–9	4–4	7–8	82.3–86.7	quite immature	quite immature
4.3	30.3	9–9	4–5	8–8	79.4–95.0	quite immature	quite immature
4.3	28.3	8–9	5–5	8–8	94.9–100.0	quite immature	quite immature
5.1	27.1	9–9	6–6	11–11	89.0–93.2	quite immature	quite immature
5.3	28.9	9–9	6–6	11–12	84.6–87.7	quite immature	quite immature
5.4	29.0	8–8	5–6	10–11	93.6–98.6	rudimentary	quite immature
5.6	29.7	8–8	6–6	11–12	78.2–87.5	quite immature	quite immature
5.9	28.1	9–9	6–6	12–12	74.4–86.9	quite immature	quite immature
6.0	29.0	8–9	5–6	12–12	91.4–91.7	quite immature	quite immature
6.1	29.3	8–8	6–6	11–13	79.1–88.4	early stage of maturity[1]	quite immature
6.1	28.4	8–8	6–7	15–16	83.5–87.6	mature[1]	quite immature
6.2	28.9	8–8	7–7	14–15	88.2–89.1	quite immature	quite immature
6.7	27.3	8–9	8–8	14–15	79.2–82.5	quite immature	quite immature
6.7	30.5	9–9	6–7	12–13	59.1–62.6	fully mature[2]	very low
6.8	28.7	8–9	5–6	13–14	74.3–82.3	quite immature	quite immature
7.5	28.5	8–8	8–10	17–19	68.3–73.3	fully mature[2]	very low
7.6	29.1	8–8	9–10	16–17	86.7–88.3	fully mature[2]	low

On the other hand, the presence of rayless zones in the anterior and posterior fins is a very important characteristic of *S. bedoti*. The essential structure of the seminal vesicle is quite the same in both *S. bedoti* and the present specimens. Numbers of anterior and posterior teeth of the present specimens are quite the same as those found in individuals of *S. bedoti* f. *minor* of corresponding body sizes. Only the hooks of the present specimens seem to be too numerous for *S. bedoti* f. *minor*. However, it is not strange that the hooks are more numerous in smaller individuals of the present specimens than in larger individuals of *S. bedoti* f. *minor*, as the hooks may wear out with growth in some species.

In considering the above-mentioned features altogether, we are now of the opinion that these specimens are but a form of *S. bedoti* limited to waters of a strongly neritic nature. The smaller body size, and the distinct collarette behind the neck might be accepted as characteristics of the present specimens and which distinguish them from *S. bedoti* f. *minor*. Generally, the typical form of *S. bedoti* and f. *minor* are found further offshore where the salinity is 29.5 parts per thousand or more, although their distributions are confined to the neritic water masses along the continents. For these reasons, the present specimens are named *Sagitta bedoti* forma *littoralis*.

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[1] Anterior end at the level of the middle of the anterior half of the posterior fin above the septum.

[2] Anterior end at or near the anterior end of the posterior fin.

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BULLETIN OF THE NATIONAL MUSEUM SINGAPORE

No. 33 **APRIL 16, 1965** **Part 2**

A review of the Brackish Water Prawns of Malaya

By D.S. JOHNSON
Zoology Department, University of Singapore
(*Received, July 1963*)

INTRODUCTION

The purpose of this note is to bring together in one place, published and unpublished data accumulated in recent years on the occurrence of prawns in Malayan brackish waters. In addition to low salinity, i.e., oligohaline, brackish areas, there are in Malaya extensive areas of mangrove swamps with creeks and ponds which are polyhaline. This mangrove environment is characterized, in addition to its relatively high salinity, by a rich supply of organic matter, contained especially in the bottom sediments. Available evidence indicates that the prawn faunas of these oligohaline and polyhaline zones are quite distinct.

PENAEIDAE

Many members of this family occur in abundance in mangrove swamps. They form the basis of a profitable prawn pond industry at Singapore and in adjoining areas of South Johore. The prawns enter the swamps as juveniles and return to the sea to breed. Hall (1956, 1961 & 1962) has given a rather comprehensive account of these prawns and their biology in Singapore prawn ponds. Though his conclusions are based almost entirely on a single pond in the Jurong swamps, collecting in other ponds confirms their general validity. Hall (1962) has also given some information on the prawns of the Merbok estuary in Perak.

Hall (1962) records a single individual of *Parapenaeopsis affinis* (H. Milne Edwards) from the Merbok estuary and a single individual of *Trachypenaeus fulvus* Dall from the Jurong prawn pond. Both should be regarded as accidental occurrences in brackish waters. The truly brackish water penaeids all belong to the genera *Penaeus* and *Metapenaeus*.

Hall (1962) lists the following species as occurring in Singapore prawn ponds:

Penaeus indicus H. Milne Edwards
P. merguiensis de Man
P. monodon Fabricius
P. semisulcatus de Haan
Metapenaeus ensis (de Haan)
M. intermedius (Kishinouye)
M. lysianassa (de Man)
M. mastersii (H. Milne Edwards)
M. mutatus (Lanchester)
M. spinulatus Kubo
M. brevicornis (H. Milne Edwards)

In 1956 he had also recorded *P. penicillatus* Alcock; but he corrected this record in 1962.

Of these species *Metapenaeus ensis*, *M. mastersii*, and *P. indicus* are by far the most abundant. It is difficult to distinguish juveniles of *P. merguiensis* from *P. indicus;* but the available evidence indicates that *P. merguiensis* is comparatively rare.

Of these species Hall reports the following: *Metapenaeus brevicornis*, *M. mastersii*, and *M. mutatus*, from an apparently polyhaline location in the Merbok estuary. In addition he records *M. dobsoni* (Miers) from this locality. *M. dobsoni* is an Indian species for which the Merbok estuary forms the most south-easterly known locality.

According to the data given by Hall the salinity of the pond which he investigated varied considerably; but, except in the months of November and December, it remained above 20 parts per thousand. Even then it rarely fell below 10 parts per thousand. In casual collecting in Singapore and Johore, both in ponds and in estuaries, I have encountered this prawn association in salinities in the region of 18–20 parts per thousand. The list thus represents the Penaeidae of polyhaline habitats. In such habitats the penaeids are the dominant prawns.

By contrast penaeids are relatively rare in mesohaline and oligohaline habitats. The young of two species are fairly frequent in waters with salinities down to about 5 parts per thousand in Singapore and southern Johore. These are *M. brevicornis* and *M. lysianassa*. I have never encountered the more important prawn pond species in such waters. Both *M. brevicornis* and *M. lysianassa* have occurred in waters which, whilst tidal, showed no detectable salinity at the time of collection; but such occurrences are infrequent.

SERGESTIDAE

Acetes vulgaris Hansen is abundant in polyhaline waters around Malayan coasts. Hall (1962) notes it as occurring in prawn ponds in Singapore and I have seen it in prawn ponds in Johore. In certain areas, as around Kukup in South Johore and at Penang, it is sufficiently abundant to support an important prawn fishery. Like most penaeids it does not penetrate into oligohaline waters.

ATYIDAE

Certain species of *Caridina* are characteristic of oligohaline waters in Malaya and may occur there in great abundance. Species which I have found as adults in such waters include:

Caridina gracilirostris de Man

C. propinqua de Man

C. tonkinensis Bouvier

C. thambipillaii Johnson

The first three of these are especially characteristic of waters with salinities between 0–3 parts per thousand. All are common in suitable localities in southern and western Malaya, at least as far north as Penang. All have been found in habitats which, whilst tidal, had no detectable salinity. Only *C. propinqua*, the commonest of the three has been found in habitats unconnected with the sea, though *C. tonkinensis* has occurred in pools in the Paya Lebar area which are only very intermittently so connected. None of these species has been found in freshwater habitats at any great distance from the sea. *C. gracilirostris* has also occurred in the Sungei Seletar in polyhaline waters with salinities in the region of 18–20 parts per thousand. *C. thambipillaii* was described from two Malayan localities (Johnson, 1961a), one of which was a brackish ditch with a salinity of 2.77 parts per thousand. I have recently examined specimens from a presumed brackish pond near Rangoon.

Of the other Malayan species, I have taken *C. simoni peninsularis* Kemp in tidal but non-saline waters. *C. typus* H. Milne Edwards is confined as an adult to freshwaters; but very small stages are not found there. Such stages are so far unknown from Malaya; but I have seen specimens from other parts of the species range which were collected in marine and brackish habitats. *Atya spinipes* Newport has a similar life history.

Thus only three Malayan species appear to be purely freshwater organisms in Malaya: *Caridina excavatoides* Johnson; *C.* cf. *babaulti* Bouvier; and *C. weberi sumatrensis* de Man.

ALPHEIDAE

Alpheus microrhynchus de Man is an inhabitant of polyhaline waters and is not uncommon in mangrove creeks and prawn ponds.

A. paludosus Kemp is comparatively rare. It has been found in salinities as high as 20 parts per thousand; but is more frequently taken in lower salinities. I have several times taken it in freshwaters above the limit of tidal influence in the Sedili basin of South Johore. Tweedie (1938) reports an alpheid prawn, presumably the same species, from a tidal but non-saline habitat in the same area.

PALAEMONIDAE

The following species of the subfamily Palaemoninae are characteristic, and often abundant, inhabitants of polyhaline waters, including mangrove creeks and prawn ponds:

Leandrites deschampsi (Nobili)

Palaemon (*Palaeander*) *semmelinkii* (de Man)

Macrobrachium equidens (Dana)

Leptocarpus potamiscus (Kemp)

Of these the first is common in Singapore island, but has not so far been reported from elsewhere (Johnson, 1962a). *Palaemon (Palaeander) semmelinkii* was not mentioned by Hall; but it is a common inhabitant of mangrove creeks and it has been found in prawn ponds. *Macrobrachium equidens* is sometimes very abundant, as has been previously noted by Hall (1962); but it is seldom as abundant as the penaeids. *Leptocarpus potamiscus* is a northern species which was reported from Penang by Kemp (1917) and Holthuis (1950). I have seen specimens from Penang and Prai and also from mangroves at Port Swettenham, which is its most southerly known locality. *Macrobrachium equidens* occurs in marine habitats, though relatively rare there (Holthuis, 1950; Johnson, 1962a). *Palaemon (Palaeander) semmelinkii* is also known from marine habitats (Johnson, 1962a).

Most other Malayan members of the Palaemoninae are either entirely marine or entirely freshwater. *M. rosenbergii* (de Man) lives in freshwater for most of its life; but the adults return to saline waters to breed. Ling and Merican (1962) and Ling (1962) have shown that the larvae cannot survive in freshwater; but the post-larval juveniles are euryhaline and migrate upstream into freshwater areas. General distributional information indicates that this species has a similar life-cycle in other parts of its range, though Mendis and Fernando (1962) list it as being a brackish water species in Ceylon. From its distribution (Johnson, 1962b) it seems probable that *M. palawanense* Johnson has a similar life cycle. The localities from which I have collected specimens in Malaya have all been close to the tidal zone.

Only one species of the subfamily Pontoniinae has been found in Malayan brackish waters. This is *Periclimenes calmani* Tattersall. This species is common in brackish waters of the Suez Canal (Holthuis, 1956) where it is the only pontoniine found. It thus appears to be a truly brackish water species. It has not been found in fully euhaline waters in Malaya.

GENERAL COMMENTS

Brackish water prawns in Malaya appear to fall into three groups: (*a*) species in which the adult is an inhabitant of freshwaters but the larval stages are passed through in salt water; (*b*) species which are characteristic of oligohaline waters; (*c*) species which are characteristic of polyhaline waters. Many, but not all, of the latter have only their juvenile stages in brackish waters, reproduction occurring in marine habitats.

Group (*a*) includes *Caridina typus*, *Atya spinipes*, *Macrobrachium rosenbergii*, and possibly *M. palawanense*. Group (*b*) includes *Caridina gracilirostris*, *C. propinqua*, *C. tonkinensis*, *C. thambipillaii*, and *Alpheus paludosus*. Group (*c*) includes *Alpheus microrhynchus*, *Leandrites deschampsi*, *Palaemon* (*Palaeander*) *semmelinkii*, *Periclimenes calmani*, and the brackish water Penaeidea.

Taken as a whole the brackish water prawn fauna of Malaya is noticeably rich. One striking absentee is the genus *Palaemonetes*, characteristics of brackish waters in most parts of the world. *Palaemonetes* barely penetrates into the Oriental Region, although it reappears in Australia (Johnson, 1961b). This absence is somewhat surprising since according to the list given by Holthuis (1950), species of the genus occur in tropical South America and tropical West Africa. A partial explanation may be the presence in the Oriental Region of several small species of *Macrobrachium* such as *M. lamarrei* and *M. lanchesteri* which occupy much the same ecological niche as that in which freshwater species of *Palaemonetes* are found. The South American species of *Palaemonetes* are true freshwater forms, and the account given by Holthuis (1959) of the habitat of *P. carteri* Gordon in Suriname is very suggestive of the habitats of these small oriental species of *Macrobrachium*. The problem still remains as to why no species of the genus has been found in oligohaline waters in the Oriental Region, at least beyond its northernmost fringe. In northern temperate regions *Palaemonetes* is a very characteristic inhabitant of this oligohaline zone. In Malaya oligohaline waters are characterized by the almost complete absence of members of the family Palaemonidae, a phenomenon which is especially striking in view of the abundance of members of this family in local freshwaters and polyhaline waters.

Workers on the brackish waters of temperate regions usually only recognize a single brackish fauna as distinct from euryhaline species of freshwater or marine origin which spread into the brackish zone (Remane, 1958). The distribution of Malayan brackish water prawns would indicate that there are two such associations in Malaya, one characteristic of oligohaline and one of polyhaline waters.

Other groups of organisms are less well worked out; but the information available on them lends support to this conclusion. Amongst the crabs, the common edible crab, *Scylla serrata* (Forskal) is a characteristic inhabitant of mangrove creeks. Adults are never found in oligohaline waters and young individuals are rare there. Certain species of *Sesarma* have a similar distribution. *Varuna litterata* (Fabricius) occasionally occurs in low salinity waters with salinities in the region of 5 parts per thousand or even less. On the other hand several species of *Sesarma* are characteristic of the oligohaline zone (see Tweedie, 1940). *Potamocypoda pugil* Tweedie probably also belongs to this group. Tweedie (1938) described it from a non-saline tidal stream and I have seen specimens from a neighbouring stream with similar characteristics. In both it was associated with the oligohaline prawn, *Alpheus paludosus*. A considerable number of fishes, including the peculiar family Phallostethidae, seem to have their headquarters in the polyhaline zone. They either do not extend into the sea or oligohaline waters, or are much rarer there. The cyprinodont, *Oryzias javanicus* (Bleeker), though it extends into polyhaline and freshwaters seems to have its headquarters in the oligohaline zone. Many molluscs are characteristic of polyhaline waters. These include members of the genera *Cerithidea* and *Terebralia*, and *Syncera brevicula* (Pfeiffer) and *Telescopium telescopium*

(Linnaeus), amongst the snails, and the bivalve *Geloina ceylonica* (Lamarck). By contrast the snails, *Neritina violacea* (Gmelin), *Faunus ater* (Linnaeus), and *Melanoides ricqueti* (Grateloup) appear to be centred on the oligohaline zone.

There is thus sufficient evidence to postulate that, at least in the south-east Asian tropics, there are two brackish water faunal groups. A larger group with many species is centred on the polyhaline zone, whilst a smaller group characterizes the oligohaline zone. The simple picture postulated for brackish water faunas in temperate regions would thus be inapplicable to this area of the tropics.

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Some fresh-water Oligochaeta of Singapore

By K. V. NAIDU

S.R.R. & C.V.R. Government College, Vijayawada, India

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INTRODUCTION

Only four species of naidid fresh-water oligochaetes, viz, *Allodero malayana* (Stephenson), *A. lutzi* (Michaelsen), *Dero dorsalis* Ferroniere, and *Allonais paraguayensis paraguayensis* (Michaelsen), are known from the Malay Peninsula (Stephenson, 1931). However, from the neighbouring islands of Sumatra and Java, 19 species of fresh-water oligochaetes belonging to three families have been recorded (Michaelsen and Boldt, 1932). This paper deals with 11 species of worms belonging to seven genera and three families, of which *Allonais lairdi* is a new species and the others are new records for Malaya. Among the latter, four are known from Sumatra and Java. Hence there is every reason to believe that some of the other species known in those islands may occur in Malaya. *Branchiodrilus semperi* (Bourne), *Aulophorus michaelseni* Stephenson, *A. hymanae* Naidu and *Allonais rayalaseemensis* Naidu, which were till now known only from India, are now recorded from Malaya, thus extending their distribution.

A key to all the valid and known species of the genus *Allonais*, including the new species herein described, is also included.

MATERIALS AND METHODS

Dr. Marshall Laird of the Division of Environmental Biology, World Health Organization, Geneva, Switzerland, collected some fresh-water oligochaetes in and around Singapore during 1954–1957, while he was working at the University of Singapore. He was assisted in the field and laboratory by Mr. C. A. Caldwell. He kindly sent me the material belonging to 11 species mounted in about 30 slides, together with the ecological data of the localities (Table 1).

All the material was passed through the alcohol-xylol series in bulk, stained in Delafield's haematoxylin, and mounted in Stafford Allans' "Sira" mountant. (Fixation was routinely in Davis' modification of Worcester's formol-mercuricacetic mixture — 75 c.c. saturated solution mercuric chloride, 20 c.c. 40% formaldehyde, 5 c.c. glacial acetic acid).

The descriptions given here are based on the examination of the mounted material. Studies were made chiefly on: —the type of prostomium; number, shape, position and length of setae; nodular position of the setae; position of stomach and dorsal vessel; dimensions of the worms; presence or absence of coelomocytes and branchial apparatus; and gut contents including intestinal parasites. Hair-setae and needle-setae are referred to below as hairs and needles respectively. The position of the nodulus is given in the ratio D:P: : (i.e., length of the shaft distal to nodulus : length of the shaft proximal to the nodulus : :). The segments are referred to by Roman numerals.

TABLE 1

COLLECTOR'S ECOLOGICAL DATA OF LOCALITIES

Locality Number and Type of Locality	Date	Time (hours)	Water Temperature (°C)	pH	Name of worm and Remarks
1 (marsh)	12-12-1955	0815	27	6.8	*Limnodrilus hoffmeisteri*
4 (large permanent pond, almost 100 per cent duckweed cover)	18-8-1955	0835	26	7.0	*Aulophorus hymanae*
	30-9-1955	0935	29	7.2	*Dero nivea* from submerged rotting leaves
	16-2-1956	1035	27	7.0	*Acolosoma bengalense*, *Allonais ravalaseemensis* from tightly rolled dead leaf cylinder
	20-2-1956	—	—	—	*Aeolosoma bengalense*
6 (large permanent pond, water hyacinth dominant plant)	15-8-1955	0910	25	6.6	*Aeolosoma bengalense*
7 (flowing stream)	5-8-1955	1025	26	6.4	*Branchiodrilus semperi* *Limnodrilus hoffmeisteri*
	19-8-1955	0750	27	6.6	*Dero nivea* on shell of two snails — *Gyraulus chinensis* (Dunker) & *Vivipara polyzonatus* (Frauenfeld)
8 (large permanent pond)	16-8-1955	1110	27	6.8	*Dero nivea* and *Pristina proboscidea*
12 (cement-lined container)	23-8-1955	1030	27	6.8	*Aulophorus tonkinensis* from mud on shell of *Gyraulus chinensis* (Dunker)
	1-9-1955	1105	27	6.8	*Allonais rayalaseemensis*
16 (Taro leaf axil)	15-8-1955	1020	26	—	*Allonais rayalaseemensis*
X17 (flowing open drain)	17-2-1956	1040	28	6.8	*Allonais rayalaseemensis*

TABLE 1 — *continued*

Locality Number and Type of Locality	Date	Time (hours)	Water Temperature (°C)	pH	Name of worm and Remarks
X18 (cement-lined pond, 5 feet wide)	10-10-1955	0950	28	7.0	*Aulophorus michaelseni* *Allonais rayalaseemensis* *Allonais gwaliorensis* β-mesosaprobic. Masses of green algae (*Spirogyra* sp.) present
X24 (large permanent pond, water hyacinth dominant)	4-4-1956	—	—	—	*Allonais rayalaseemensis* β-mesosaprobic
X26 (flowing stream)	14-10-1955	1110	30	6.0	*Allonais rayalaseemensis* β-mesosaprobic
X28 (large permanent pond, duckweed cover at margins)	28-10-1955	0840	29	6.8	*Allonais rayalaseemensis* β-mesosaprobic
X29 (small permanent pond)	18-10-1955	1055	29	6.4	*Aulophorus michaelseni* α-mesosaprobic
X41 (permanent pond, emergent grasses)	6-2-1956	0935	26	6.8	*Allonais lairdi* α-mesosaprobic
X52 (pond in bed of drain)	29-3-1957	—	—	—	*Limnodrilus hoffmeisteri* — in knots at bottom on mud *Allonais gwaliorensis* — pelagic naid with helical movement
	4-4-1957	—	31	6.6	*Allonais rayalaseemensis*, *Aulophorus hymanae* and *Allonais gwaliorensis* — in masses of *Oscillatoria decolorata* G.S. West and *O. tenuis* var. *tergestina* Rab. on bottom

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I am extremely thankful to Dr. Marshall Laird for so kindly giving me the material reported herein, and Dr. Christina Sperber of Uppsala, Sweden, for her assistance in securing the material from Dr. Laird and for her valuable suggestions made during the preparation of this paper.

SYSTEMATIC ENUMERATION

Family AEOLOSOMATIDAE

Genus *Aeolosoma* Ehrenberg, 1831

Aeolosoma bengalense Stephenson, 1911

A. bengalense Marcus, 1944, pp. 16–17, figs. 2A & 2B; Naidu, 1961, pp. 648–649, figs. 1A & 1B.

Material examined.—Three specimens collected from localities 4 and 6 on 20.2.1955 and 15.8.1956 respectively.

Prostomium flatly rounded with its diameter equal to body diameter. Dorsal and ventral bundles have simple straight hairs, up to 4 per bundle, 160u long dorsally and up to 6 per bundle, 250u long ventrally. Pharynx in II, oesophagus in III, stomach in IV–IX. Coelomocytes absent. Dorsal vessel mid-dorsal.

Length (preserved): 1.0–1.3 mm.; diameter (preserved): 0.3 mm.; s: 10–12; n: 9.

Gut contents.—Diatoms and filamentous algae.

Parasites.—*Radiophryoides aelosomatis* (Anderson), an astomatous holotrichous ciliate, lives in the gut of some worms. It has also been recorded from the Indian worms.

Further distribution.—India, Java and Japan, (Asia); Paraguay, and Brazil (S. America).

Family NAIDIDAE

Sub-family Naidinae Lastockin, 1924

Genus *Branchiodrilus* Michaelsen, 1900

Branchiodrilus semperi (Bourne, 1890)

B. semperi Sperber, 1948, pp. 156–157; Naidu, 1962a, pp. 526–527, figs. 11A–11F.

Material examined.—Four specimens collected from locality 7 on 5.8.1955.

Prostomium bluntly triangular. Gills filiform, one pair per segment dorsolaterally, from VI to middle of body. Dorsal bundles start in VI, all composed of 1 straight hair of 300–350u long and 1 simple-pointed needle without nodulus, of 80–90u long, of two types — straight needles in anterior segments and peculiar bayonet-shaped needles in posterior segments. Ventral setae of II–V are 1–2 per bundle, 105–110u long, with median nodulus (D: P: : 15: 16) and with distal prong thinner and shorter than proximal; in other segments 2–3 per bundle, 105–120u long, with distal nodulus (D: P: : 14: 20 or 12: 20) and with distal prong thinner and longer than proximal. Stomach absent. Coelomocytes spherical and granular, 18u in diameter. Dorsal vessel ventro-lateral but mid-dorsal in anterior 5 or 6 segments.

Length (preserved): 8–12 mm.; diameter (preserved): 0.5–0.6 mm.; s: 70–94.

Further distribution.—South India.

Genus *Dero* Oken, 1815

Dero nivea Aiyer, 1930

D. nivea Sperber, 1948, pp. 184–186, fig. 19g, pl. 18, fig. 4; Naidu, 1962b, pp. 540–541, figs. 17A–17C.

Material examined.—Nine specimens collected from localities 4, 7 and 8, on 30.9.1955, 19.8.1955 and 16.8.1955 respectively.

Prostomium bluntly triangular. Dorsal bundles start in VI, 1 hair and 1 needle per bundle; hairs bayonet-shaped, 75–90u long; needles bifid, 42–44u long, with distal nodulus (D: P: :4: 9) and with equal teeth. Ventral setae of II–V are 3 per bundle, 77u long in II, gradually decreasing to 52u long in V, less curved with proximal nodulus and with distal prong twice as long as proximal; in others, segments 3–4 per bundle, 48–56u long, with distal nodulus (D: P: : 7: 9) and with prongs equally long, distal prong thinner than proximal. Stomach in VIII or ½VIII–½IX. Gills 3 pairs, digitate.

Length (preserved): 2.5–3.0 mm.; diameter (preserved): 0.26 mm.; s: 25–28 + branchial organ.

Gut contents.—Diatoms, desmids and filamentous algae.

Remarks.—Collected from scrapings from the valves of fresh-water molluscs.

Further distribution.—Europe; Palestine, India and China (Asia).

Genus *Aulophorus* Schmarda, 1861

Aulophorus michaelseni Stephenson, 1923

A. michaelseni Stephenson, 1923, pp. 93–94, fig. 35; Naidu, 1962b, pp. 902–904, figs. 21A–21E.

Material examined.—Four specimens collected from localities X18 and X29 on 10.10.1956 and 18.10.1956 respectively.

Prostomium bluntly triangular. Branchial organ with 1 pair of palps and 4 pairs of digitate gills. Dorsal bundles begin in V, 1 hair and 1 needle per bundle; hairs bayonet-shaped, 120–150u long; needles sickle-shaped, bifid, 50u long with distal nodulus (D: P: : 5: 9), and with teeth equally long and thick. Ventral setae 4–5 per bundle, in II–V less curved, 52–60u long, with median nodulus (D: P: : 9: 8) and with prongs equally thick, distal prong longer than proximal; in other segments 45–50u long, with distal nodulus (D: P: : 6: 8) and with distal prong thinner and shorter than proximal. Coelomocytes 10u in diameter. Stomach absent. Dorsal vessel mid-dorsal in anterior 6 segments and ventro-lateral in others.

Length (preserved): 4–5 mm.; diameter (preserved): 0.25 mm.; s: 38 + undifferentiated region and branchial organ; n: 18–20.

Further distribution.—India.

Aulophorus hymanae Naidu, 1962

A. hymanae Naidu, 1962b, pp. 905–908, figs. 22A–22F.

Material examined.—Two specimens collected from localities 4 and X52 on 18.8.1955 and 4.4.1957 respectively.

Prostomium bluntly triangular. Branchial organ with 2 short palps and 3 pairs of foliate gills. Dorsal bundles begin in V, 1 hair and 1 needle per bundle; hairs bayonet-shaped, 180–200u long; needles sickle-shaped, bifid, 60u long, with distal nodulus (D: P: : 7: 10) and with distal tooth thinner and longer than proximal. Ventral setae in II–V are 3 per bundle, less curved, about 65u long, 2.5u thick with proximal nodulus (D: P: : 10: 8) and with distal prong thinner and longer than proximal, prongs diverging; in other segments 3–4 per bundle, curved, 60–64u long, 3u thick, with distal prong thinner and slightly longer than proximal. Stomach absent. No coelomocytes. Dorsal vessel mid-dorsal in anterior 6 segments and ventro-lateral from VII on.

Length (preserved): 4–5 mm.; diameter (preserved): 0.24 mm.; s: 41 + branchial organ; n: 22.

Further distribution.—South India.

Aulophorus tonkinensis (Vejdovsky, 1894)

A. tonkinensis Michaelsen, 1909, p. 132; Stephenson, 1911, pp. 212–214; Sperber, 1948, pp. 196–197; Naidu, 1962b, pp. 911–914, figs. 24A–24H.

Material examined.—One specimen collected from locality 12 on 23.8.1955.

Prostomium broader than long. Branchial organ with 1 pair of thin palps of 0.3 mm. long and 2 pairs of digitate gills. Dorsal bundles start in VI, 1 hair and 1 needle per bundle; hairs straight up to 150u long; needles oar-shaped, 63–74u long, with distal nodulus (D: P: : 8: 13). Ventral setae of II are 4–5 per bundle, less curved, 70–77u long, with median nodulus (D: P: : 10: 11) and with equally thick prongs, distal prong longer than proximal; in other segments are 4–6 per bundle, curved, 60–63u long, with distal nodulus (D: P: : 7: 11) and with distal prong thinner and shorter than proximal. Stomach absent. No coelomocytes. Dorsal vessel ventro-lateral for most part and mid-dorsal in head segments.

Length (preserved): 2.5–2.8 mm.; diameter (preserved): 0.3 mm.; s: 29–32 + branchial organ; n: 16.

Further distribution.—India, China, Java (Asia); Madagascar and Africa.

Genus *Allonais* Sperber, 1948

Allonais lairdi sp. nov. Figures 1a–1d.

Material examined.—Several specimens collected from locality X41 on 6.2.1956.

Prostomium bluntly triangular. Dorsal bundles begin in VI, 1 hair and 1 needle per bundle; hairs straight, up to 350u long; needles (fig. 1a) bayonet-shaped, simple-pointed, 63–66u long with distal nodulus (D: P: : 7: 11). Ventral setae (figs. 1b & 1c) of II–V are slightly different from those of following segments. In II–V they are 5–6 per bundle, 49–54u long with distal nodulus (D: P: : 6: 8) and with equally thick prongs, distal prong longer than proximal, in other segments they are 4–8 per bundle, 42–46u long, with distal nodulus (D: P: : 5: 8 or 6: 8) and with distal prong thinner and shorter than and resembling the proximal. Pharynx in II–IV with a dorsal diverticulum, oesophagus begins in V, wavy, continues inperceptably into intestine; stomach absent; chloragogues from VI on. No septal glands; coelomocytes could not be made out. Brain incised in front and behind. Dorsal vessel mid-dorsal in anterior 5 or 6 segments and ventro-lateral from VI or VII onwards. Budding zones absent in worms examined. Clitellum in $\frac{1}{2}$V–VII. Penial setae (fig. 1d) are modified ventral setae of VI, 4–5 per bundle, 49–53u long with distal simple hook. Sperm-sac and ovi-sac are posterior diverticula of septa 4/5 and 5/6, and extend to XII and XIII respectively, when full of sperms and ova. Atrium spherical, 42u in diameter.

Length (preserved): 7–9 mm.; diameter (preserved): 0.2 mm.; s: 54–87 + undifferentiated region.

Gut contents.—Diatoms and filamentous algae.

Taxonomic discussion.—The present worms very closely resemble *Nais simplex* Piguet and actually were so identified. The absence of a stomach, absence of fission zones, ventral setae of II–V not very different from those in the following segments; absence of septal glands, places it in *Allonais*. This form with simple-pointed needle differs from all the known species of the genus, which have either bifid or pectinate needles. Hence it is described as a new species and named after its collector Dr. Marshall Laird of the World Health Organization, Geneva, Switzerland.

Diagnosis.—Eyes absent. Dorsal bundles from VI onwards, each bundle composed of 1 straight hair and 1 simple-pointed needle with distal nodulus. Ventral setae of II–V are slightly different from those of the following segments; in II–V 5–6, in others 4–8 per bundle. No septal glands. Stomach absent. Dorsal vessel mid-dorsal in anterior 6 segments, ventro-lateral from VI onwards. Clitellum in $\frac{1}{2}$V–VII. Penial setae 4–5 per bundle. Atrium spherical.

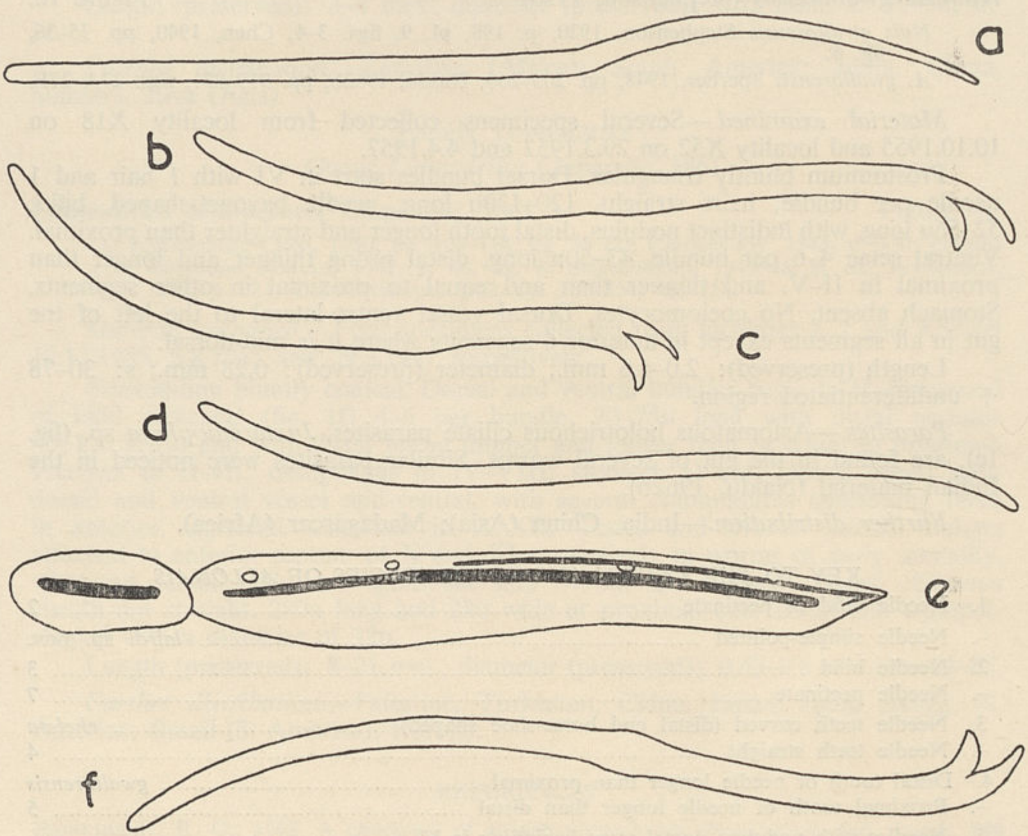

Figure 1. (a-d) *Allonais lairdi* sp. nov. (a) Needle seta X2000. (b) Ventral seta of III segment X2000. (c) Ventral seta of middle segment X2000. (d) Penial seta X2000. (e) *Allonais gwaliorensis* (Stephenson), parasitic ciliate chain X575. (f) *Limnodrilus hoffmeisteri* Claparede, dorsal and ventral seta X1500.

Allonais rayalaseemensis Naidu, 1962

A. rayalaseemensis Naidu, 1962b, pp. 917–919, figs. 26A–26F.

Material examined.—Several specimens collected from localities 4, 12, 16, X17, X18, X24, X26, X28 and X52 on 16.2.1956, 1.9.1955, 15.8.1955, 17.2.1956, 10.10.1955, 4.4.1956, 14.10.1955, 28.10.1955 and 4.4.1957 respectively.

Prostomium bluntly triangular. Dorsal setae begin in VI, 1 (rarely 2) hair and 1 (rarely 2) needle per bundle; hairs simple, straight, 280–320u long; needle bayonet-shaped, bifid, 77–88u long, with distal nodulus (D: P : : 10: 14) and with straight and diverging teeth, proximal tooth thicker and nearly twice as long as distal. Ventral setae all similar, 3–4 per bundle in II–V, 5–7 in other segments, about 70u long, with median nodulus (D: P: : 9: 11 or 10: 10) and with distal prong thinner than proximal in II–V, longer and equal to proximal in others. Stomach absent. No coelomocytes. Dorsal vessel ventro-lateral to left of the gut from hind end to VII and mid-dorsal from VI cephalad. Anal opening postero-dorsal.

Length (preserved): 6.4–8.5 mm.; diameter (preserved): 0.37 mm.; s: 80–90 + undifferentiated region.

Further distribution.—South India.

Allonais gwaliorensis (Stephenson, 1920) Figure 1e.

Nais gwaliorensis Stephenson, 1920, p. 198, pl. 9, figs. 3–4; Chen, 1940, pp. 35–36, fig. 6.

A. gwaliorensis Sperber, 1948, pp. 205–206; Naidu, 1962b, pp. 919–921, figs. 27A–27F.

Material examined.—Several specimens collected from locality X18 on 10.10.1955 and locality X52 on 29.3.1957 and 4.4.1957.

Prostomium bluntly triangular. Dorsal bundles start in VI with 1 hair and 1 needle per bundle; hairs straight, 120–130u long; needle bayonet-shaped, bifid, 52–56u long, with indistinct nodulus, distal tooth longer and straighter than proximal. Ventral setae 4–6 per bundle, 43–50u long, distal prong thinner and longer than proximal in II–V, and thinner than and equal to proximal in other segments. Stomach absent. No coelomocytes. Dorsal vessel ventro-lateral to the left of the gut in all segments except in anterior 6 segments where it is mid-dorsal.

Length (preserved): 2.0–4.6 mm.; diameter (preserved): 0.28 mm.; s: 30–78 + undifferentiated region.

Parasites.—Astomatous holotrichous ciliate parasites, *Juxtaradiophrya* sp. (fig. 1e), are found in the gut of several worms. Similar parasites were noticed in the Indian material (Naidu, 1962b).

Further distribution.—India, China (Asia); Madagascar (Africa).

KEY TO THE KNOWN AND VALID SPECIES OF *ALLONAIS*

1. Needle bifid or pectinate 2
–. Needle simple-pointed .... *lairdi* sp. nov.
2. Needle bifid 3
–. Needle pectinate 7
3. Needle teeth curved (distal end horse-shoe shaped) .... *chelata*
–. Needle teeth straight 4
4. Distal tooth of needle longer than proximal .... *gwaliorensis*
–. Proximal tooth of needle longer than distal 5
5. Needles with nodulus; dorsal setae beginning in VI: regenerates 5 anterior segments 6
–. Needles without nodulus; dorsal setae beginnig in VII; regenerates 6 anterior segments .... *paraguayensis aequitorialis**
6. Needle teeth parallel .... *paraguayensis paraguayensis*
–. Needle teeth diverging .... *rayalaseemensis*
7. Needles with proximal tooth longer and thicker than distal .... *inaequalis*
–. Needles with equally long and thick teeth .... *pectinata*

* Not known from Asia.

Sub-family Pristininae Lastockin, 1924

Genus *Pristina* Ehrenberg, 1828

Pristina proboscidea Beddard, 1896

P. proboscidea Chen, 1940, p. 48; Marcus, 1943, pp. 111–112, pl. 21, fig. 87, pl. 22, fig. 88; Sperber, 1948, pp. 239–240.

Material examined.—Two specimens collected from locality 8 on 16.8.1955.

Prostomium triangular with filiform proboscis of 0.2 mm. long. Dorsal bundles begin in II with 1–3 straight hairs of 400–520u long and 2–5 simple-pointed straight needles about 56u long. Ventral setae of II–V are 3–5 per bundle, 90–94u long with median nodulus (D: P: : 14: 13) and with equally thick prongs, distal prong twice as long as proximal; in other segments 4–7 per bundle, 66–74u long with distal nodulus (D: P: : 10: 12), distal prong thinner and slightly longer than proximal. Stomach in anterior half of VIII, pear-shaped with intra-cellular canals. Septal glands on septa 4/5 and 5/6. Coelomocytes 10.5u in diameter. Dorsal vessel mid-dorsal.

Length (preserved): 3–4 mm.; diameter (preserved): 0.35 mm.; s: 30–36; n: 18.

Further distribution.—Zanzibar (Africa); South America; India, China, Sumatra, Java (Asia).

Family TUBIFICIDAE

Genus *Limnodrilus* Claparede, 1861

Limnodrilus hoffmeisteri Claparede, 1861 Figure 1f.

L. hoffmeisteri Chen, 1940, pp. 109–114, fig. 30 (2); Cernosvitov, 1945, p. 530; Dubois Raymond Marcus, 1947, p. 40, fig. 8; Sciacchitano, 1947–48, p. 62; Brinkhurst, 1962, p. 321; Cekanovskaya, 1962, pp. 253–254, fig. 154.

Material examined.—Four specimens collected from localities 1, 7 and X52 on 12.12.1955, 5.8.1955 and 29.3.1957 respectively.

Prostomium bluntly conical. Dorsal and ventral bundles begin in II, composed of bifid crotchets (fig. 1f) 4–6 per bundle, 70–75u long with distal nodulus (D: P: : 9: 12) and with distal prong thinner and longer than or equal to proximal. Pharynx in II–III; oesophagus in IV–VIII; stomach absent. Dorsal vessel mid-dorsal and ventral vessel mid-ventral, with several commissures connecting them in anterior segments. Clitellum in X–XII. Testes and ovaries paired, oblong attached to anterior septum of X and XI respectively in worms of early sexuality, when no sexual cells and sperm-sac and ovi-sac are formed. Penial chitinous sheath not straight, 280u long and 28u wide at proximal end; distal end trumpet-shaped with a diameter of 32u.

Length (preserved): 8–21 mm.; diameter (preserved): 0.45–0.6 mm.; s: 43–85.

Further distribution.—Palestine, Turkestan, China, Japan, India (Asia); N. America; Brazil (S. America); Europe.

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No. 33 JUNE 21, 1965 Part 4

Notes on the Biology of the Anchovy, *Stolephorus pseudoheterolobus* Hardenberg

By THAM AH KOW

Fisheries Biology Unit, University of Singapore

(*Received, May 1965*)

INTRODUCTION

The members of the genus *Stolephorus* Lacepede are small fishes known locally in Malaysia as *Ikan Bilis*. They are the Malayan counterparts of the anchovies in other countries. In Java they are known as *Ikan Teri*. They are very popular among the indigenous people who have many ways of cooking them. In Malaysia the larger species such as *Stolephorus indicus* are usually sold in the fresh state, whilst the smaller ones such as *S. pseudoheterolobus*, *S. heterolobus* and *S. insularis*, are usually cooked in brine as soon as they are caught, and sold as cooked fish. Along the east coast of Malaya they are sometimes salted and then sundried, especially when they are caught in very large quantities. In Singapore they are caught mainly by fixed traps known as kelongs or by beach seines. Along the east coast of Malaya they are also caught by lighted purse seines.

According to Hardenberg (1934) there are nine species of *Stolephorus*. They may be divided into two main groups from the point of view of their distribution:—

I. Those with widespread distribution:

(*a*) *S. tri* (Bleeker). Philippines to Bombay.

(*b*) *S. indicus* (van Hasselt). India to Japan and Tahiti.

(*c*) *S. commersoni* Lacepede. Philippines to Madagascar.

(*d*) *S. heterolobus* Ruppell. Red Sea to Australia.

II. Those with limited distribution:

(*a*) *S. baganensis* Hardenberg. Java, Sumatra, Borneo.

(*b*) *S. insularis* Hardenberg. Java, Sumatra, Borneo, Celebes, Singapore.

(*c*) *S. pseudoheterolobus* Hardenberg. Java, Sumatra, Celebes, Singapore.

(*d*) *S. zollingeri* (Bleeker). Celebes, Java (south coast only).

(*e*) *S. celebicus* Hardenberg. Celebes only.

In the Singapore Straits four species, viz. *S. indicus, S. insularis, S. heterolobus* and *S. pseudoheterolobus* are recorded (Tham, 1953). The last species is by far the most abundant, especially from February to June and from August to November. During the period of maximum abundance a large *Kelong* could catch as much as $1\frac{1}{4}$ tons per night.

TAXONOMY

The genus *Stolephorus* belongs to the sub-family Engraulinae of the family Clupeidae. The genera of the sub-family Engraulinae are characterised by the presence of keeled abdominal scutes, a large mouth with a prominent snout and a maxillary with two supplemental bones. Members of the genus *Stolephorus* are distinguished from the other genera of the sub-family Engraulinae by the possession of a forked caudal fin which is not united with the anal fin, as well as by the presence of scutes on the ventral surface only between the pectoral fins and the ventral fins. Also the silvery hue on the body is only limited to a lateral band.

The species *S. pseudoheterolobus* may be characterised as follows: — dorsal 14–15; anal 16–18; pectoral 13–14; ventral 7. Lateral line 38. Snout rather pointed. Head 3.8–4.2 in standard length; eye 3.5–4.0 in head. Maxillary reaches to somewhat behind mandibulary joint. The ventral edge of maxillary is lined with a series of hooks with 3 to 4 large ones near the posterior end. The dorsal fin is situated a little behind the half-way point between the tip of the snout and the first rays of the caudal fin, with the anal fin somewhat behind along the ventral edge. The ventral fins are inserted in front of the vertical through the origin of the dorsal. There are 4 to 6 abdominal, needle-like scutes in front of the ventral fins. The scales are very deciduous and fall off as soon as the fish is caught in the net.

This species is differentiated from the other species of *Stolephorus* by the possession of all the following characteristics: —

(*a*) The maxillary extends to somewhat behind the mandibulary joint.

(*b*) The end of the maxillary is somewhat pointed.

(*c*) The origin of the anal is behind the dorsal.

(*d*) The height of the adult fish is 5.6 to 6.2 in standard length.

It is very closely related to *S. heterolobus* but differs from it in having a higher ratio of standard length to body height and in having a more pointed snout. The eggs of *S. pseudoheterolobus* have no oil globule, whilst in those of *S. heterolobus* an oil globule is present.

BIOLOGY

Delsman (1931), who studied the eggs and larvae of the members of the genus *Stolephorus*, came to the conclusion that the egg of *S. pseudoheterolobus* differs from those of the other species in that it has no oil globule and no knob. Like the eggs of the other species of *Stolephorus* it is elongated and has a segmented yolk (fig. 1*a*). Spawning occurs at night and by the next morning the germinal disc is formed and the larva hatches out in the evening of the same day (fig. 1*b*). By the following morning part of the yolk sac has been absorbed (fig. 1*c*). The yolk sac will be totally absorbed by the evening of the second day (fig. 1*d*). The characteristic feature of this larva is that unlike the larvae of other members of the genus, the terminal part of the gut does not extend to the border of the unpaired fin fold and the vent is situated either on the left or the right side beneath the inferior border of the myotomes. As the larva grows, there is a forward movement of the anus over a distance of about 6 myotomes.

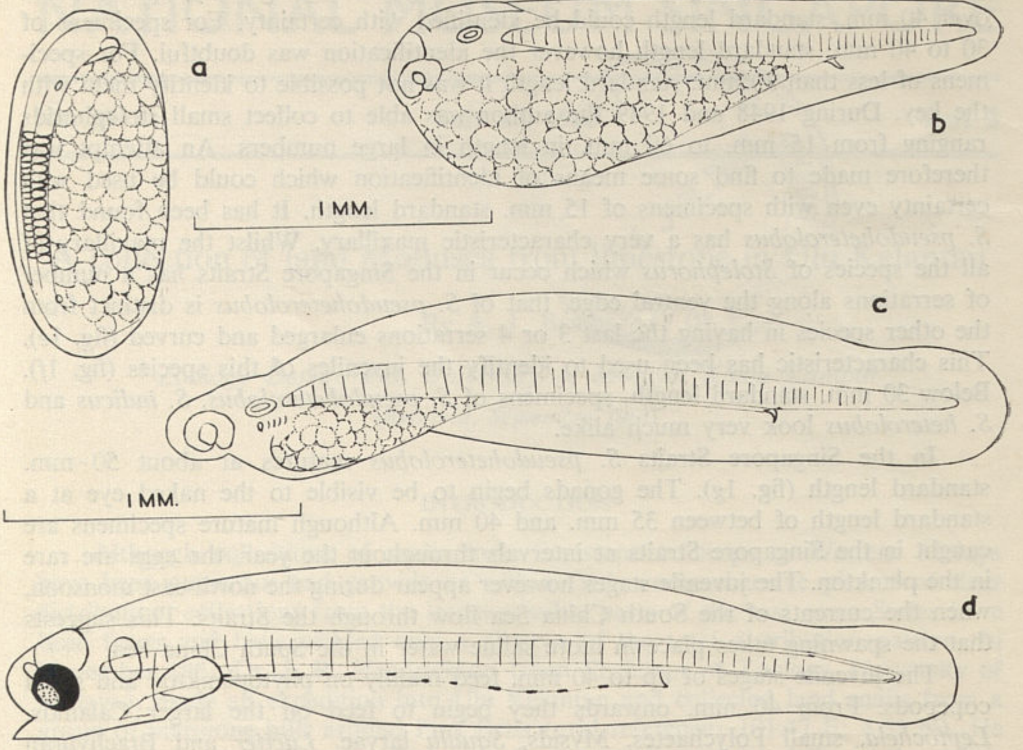

Figure 1. *Stolephorus pseudoheterolobus* Hardenberg. (*a*) Developing egg (After Delsman). (*b*) Newly hatched larva (After Delsman). (*c*) Larva, 12 hours after hatching (After Delsman). (*d*) Larva, 24 hours after hatching (After Delsman). (*e*) Maxillary of juvenile. (*f*) Juvenile stage. (*g*) Mature stage.

The work of Delsman only covered the larval stages and no work had been done on the juvenile stages of the species. Using Hardenberg's key, specimens of over 40 mm. standard length could be identified with certainty. For specimens of 30 to 40 mm. standard length however the identification was doubtful. For specimens of less than 30 mm. standard length it was not possible to identify them with the key. During 1948 and 1949 the author was able to collect small stolephorids ranging from 15 mm. to 60 mm. in length in large numbers. An attempt was therefore made to find some means of identification which could be used with certainty even with specimens of 15 mm. standard length. It has been found that *S. pseudoheterolobus* has a very characteristic maxillary. Whilst the maxillary of all the species of *Stolephorus* which occur in the Singapore Straits has a number of serrations along the ventral edge, that of *S. pseudoheterolobus* is distinct from the other species in having the last 3 or 4 serrations enlarged and curved (fig. 1*e*). This characteristic has been used to identify the juveniles of this species (fig. 1*f*). Below 30 mm. standard length, specimens of *S. pseudoheterolobus, S. indicus* and *S. heterolobus* look very much alike.

In the Singapore Straits *S. pseudoheterolobus* matures at about 50 mm. standard length (fig. 1*g*). The gonads begin to be visible to the naked eye at a standard length of between 35 mm. and 40 mm. Although mature specimens are caught in the Singapore Straits at intervals throughout the year, the eggs are rare in the plankton. The juvenile stages however appear during the north east monsoon, when the currents of the South China Sea flow through the Straits. This suggests that the spawning takes place in more saline water in the South China Sea.

The juvenile stages of up to 40 mm. feed mainly on phytoplankton and small copepods. From 40 mm. onwards they begin to feed on the larger Calanids, *Leptochela,* small Polychaetes, Mysids, *Squilla* larvae, *Lucifer* and Brachyuran and other decapod larvae. Sometimes small larval Stolephorids are found in the stomachs of the large specimens.

Predatory fish such as *Scomberomorus* spp., *Chirocentrus dorab* and *Trichiurius* spp. have been observed to feed very heavily on *S. pseudoheterolobus* when it is abundant in the Singapore Straits.

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BULLETIN OF THE
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No. 33 July 24, 1965 Part 5

A collection of land Mollusca from limestone in Ulu Kelantan

By A. J. BERRY

Zoology Department, University of Malaya, Kuala Lumpur

(*Received, September 1963*)

INTRODUCTION

Although collections of snails from limestone outcrops in Western Malaya have been numerous and provide us with a fairly comprehensive picture of their distribution, collections from the less accessible parts of the east coast States have been fewer and have yielded only a glimpse of the total distribution pattern. In November 1961 Dr. J. R. Hendrickson (then Professor of Zoology, University of Malaya), made an expedition into Ulu Kelantan and collected land snails from a group of limestone hills around Fort Betis (grid reference: 101.47 E; 4.53 N). He collected live snails from the limestone faces as well as dead shells in the debris around the bases of the hills as described by Tweedie (1961), and kindly handed the material to me.

Collections were made from five hills: Gunong "Senarip", a name given by the inhabitants of the area (hill no. 1); Gunong Renayang (hill no. 2); a small nameless hill not shown on printed maps and thus designated as hill no. 3; Gunong Pasuk (hill no. 4); and Gunong Chenaruk (hill no. 5). These hills are indicated in Figure 1, and their faunas in Table 1. The shells collected from Gua Jaya, to the north of Fort Betis (101.46 E; 5.06 N), are also listed although collection from this site was not so fruitful and snails were not taken alive from the limestone faces.

DISCUSSION

The distribution of many snails on Malayan limestone hills was reviewed by Tweedie (1961). The localities dealt with in his review which lie nearest to Fort Betis are those around Gua Musang, including Gua Madu and Batu Tongkat between Gua Musang and Pulai to the south. Gua Nenek lies about seven miles beyond Gua Musang to the south-west.

The species of *Diplommatina* are largely the same as those of the Gua Musang hills except that *D. tweediei* Laidlaw was not collected but *D. demorgani,* which Tweedie (1961) quotes as limited to Kota Tongkat and Kota Gelanggi in Central Pahang, was. The occurrence of *D. pentaechma* and *D. maduana* at Fort Betis represents a slight extension of their previously known ranges in the Gua Musang hills.

TABLE 1

Snail faunas from limestone hills near Fort Betis, Kelantan

Taxonomic list of snails	Hill number 1	2	3	4	5	Gua Jaya
Archaeogastropoda						
Hydrocenidae						
**Hydrocena monterosatiana* (Godwin-Austen and Nevill)	+	+	+	+	+	+
Mesogastropoda						
Cyclophoridae						
Cyclophorus perdix tuba (Sowerby)	+			+	+	+
Lagochilus spp.	+		+		+	+
Opisthoporus dautzenbergi Sykes	+		+		+	+
Rhiostoma asiphon v. Moellendorff					+	+
Alycaeus kelantanensis Stoliczka	+	+		+	+	+
Chamalycaeus diplochilus v. Moellendorff ...	+			+	+	
**Opisthostoma laidlawi* Sykes	+	+	+	+	+	+
**Diplommatina canaliculata* v. Moellendorff ...	+	+	+	+	+	+
D. demorgani Laidlaw			+	+		
D. maduana Laidlaw		+	+			
**D. pentaechma* Laidlaw	+	+		+		
Pupina lowi de Morgan				+		
Pulmonata						
Vertiginidae						
**Gyliotrachela hungerfordiana* v. Moellendorff ...	+	+	+	+		
Paraboysidia frequens v. Benthem Jutting ...				+		
Subulinidae						
Lamellaxis clavulinus (Potiez & Michaud) ...		+	+			+
Prosopeas tchehelense (De Morgan)			+		+	
Achatinidae						
Achatina fulica Bowdich	+				+	+
Endodontidae						
Philalanka marangensis (Aldrich)	+	+	+	+	+	+
Helicarionidae						
**Liardetia perakensis* (Godwin-Austen) ...	+	+	+	+	+	+
Hemiplecta cymatium (Pfeiffer)	+			+		+
**Coneuplecta bandongensis* (Boettger) ...	+	+	+	+	+	+
Dyakia salangana (Martens)						
Microcystina sp.	+		+	+	+	+
Macrochlamys sp.					+	+
Pleurodontidae						
Chloritis platytropis v. Moellendorff					+	
Streptaxidae						
Sinoennea crumenilla v. Benthem Jutting ...		+	+			
Discartemon platymorphus v. Benthem Jutting ...	+					
Discartemon collingei (Sykes)		+			+	+

* Asterick indicates specimens collected alive from mossy rock faces and preserved in 70 per cent alcohol.

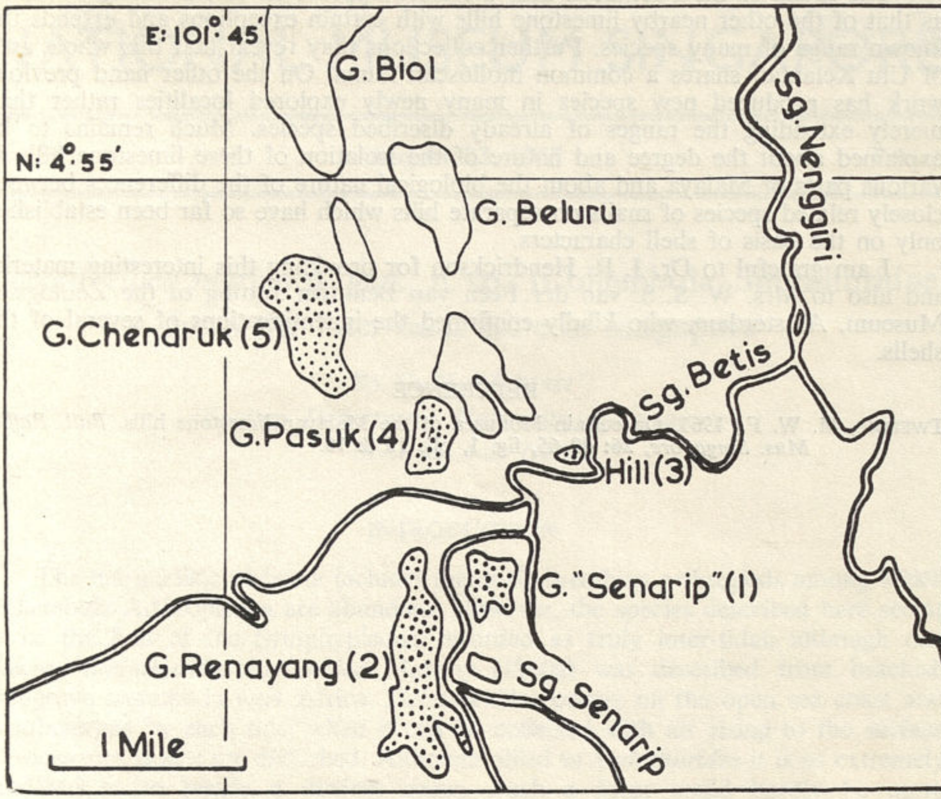

Figure 1. Sketch map of the Fort Betis area, Kelantan, showing the rivers and limestone hills. The hills from which shells were collected are stippled. Grid references are given at top left.

Neither of the two species of *Opisthostoma* recorded from the Gua Musang hills and listed by Tweedie was collected in the present instance. On the other hand, *Opisthostoma laidlawi*, previously recorded as collected from "Kelantan", occurred on all the hills and Dr. Hendrickson was able to collect and preserve several tubes full.

Of the pulmonates typically restricted to limestone, *Paraboysidia frequens* is also known from the Gua Musang hills as well as from localities in Pahang and Selangor. *Gyliotrachela hungerfordiana*, although not recorded from the Gua Musang area, is one of the most widespread vertiginids and its occurrence at Fort Betis merely extends its range into Kelantan. The streptaxids in this collection conform with species previously collected in this part of Malaya. *Discartemon collingei* is known from Gua Musang and Gua Nenek in Kelantan and from Gua Sai in Pahang and *D. platymorphus* from Gua Nenek along. Similarly, *Sinoennea crumenilla* was previously known from Gua Nenek.

Most of the rest of the snails are forms which, although known to occur in great numbers only on or near limestone, are not confined to it and have thus been recorded from widely scattered areas in either the east-central region or else the whole of Malaya.

The fauna of the Fort Betis hills therefore appears to be essentially the same as that of the other nearby limestone hills with certain exceptions and extends the known range of many species. Further collections may reveal that this whole area of Ulu Kelantan shares a common molluscan fauna. On the other hand previous work has produced new species in many newly explored localities rather than merely extending the ranges of already discribed species. Much remains to be explained about the degree and nature of the isolation of these limestone hills in various parts of Malaya and about the biological nature of the differences between closely related species of snails on separate hills which have so far been established only on the basis of shell characters.

I am grateful to Dr. J. R. Hendrickson for providing this interesting material and also to Mrs. W. S. S. van der Feen van Benthem Jutting of the Zoologisch Museum, Amsterdam, who kindly confirmed the indentifications of several of the shells.

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BULLETIN OF THE NATIONAL MUSEUM SINGAPORE

No. 33 August 23, 1965 Part 6

Deboutevillea marina n. gen., n. sp., (Collembola, Sminthuridae) from the inter-tidal zone of Singapore

By D. H. MURPHY

Zoology Department, University of Singapore

(*Received, July 1965*)

INTRODUCTION

The marine littoral fauna includes many air-breathing arthropods among which Collembola Arthropleona are abundant. However, the species described here seems to be the first of the Symphypleona recorded as truly inter-tidal, although one species, *Sminthurides avicenniae* Murphy (1960a) was described from brackish mangrove swamps in west Africa. *Deboutevillea* occurs on the open sea coast and is submerged by each tide, when it can be collected with air rising to the surface as rocks and stones are disturbed. Although allied to *Sminthurides* it is so extremely modified as to justify a distinct genus. Such a form could hardly be more appropriately dedicated than to Prof. C. Delamare-Deboutevile, leading authority both on the Symphypleona and on the marine interstitial fauna.

Deboutevillea n. gen.

A typical member of the *Sminthuridinae* in having abd.V separated from abd.IV by a distinct suture but fused with abd.VI and bearing 2+2 bothriotrichia. Ventral tube without eversible vesicles or papillae. Although a feature of the subfamily is their relatively small size, short but prominent tubular vesicles or at least papillae are present in other genera. Tenaculum with basal, clavate appendages. Female without *appendices anales*. Male with clasping antennae.

Distinguished from related genera by absence of tibiotarsal organ (cf. *Sminthurides* lat.), mucronal shape and absence of tibiotarsal or anogenital serrate spines (cf. *Denisiella*), absence of post-oral glands and presence in the male of metanotal vesicles (cf. *Sphaeridia*). Unique in having basal, lateral appendages on ventral tube, tibia II of female dilated and spinose and male with spines on frons. Genotype *D. marina* n. sp.

Deboutevillea marina n. sp. Figures 1 & 2.

Female. Size up to 0.7 mm. Pigmentation intense blue-black with some pale patches visible when cleared in lactic acid (indicated by broken lines in fig. 1*a*). Frons and clypeus (fig. 1*c*) without macrochaetae or spines. Occipital region with 2 + 2 ocular and 2 + 2 post-ocular setae. 6 + 6 equal corneae around and between which are several very distinct tubercles not corresponding to ocelli.

Antennae with segment IV (fig. 1*i*) divided into 6 simple subsegments. Body chaetotaxy as in fig. 1*a*, short. Gonopore with 2 + 2 small, simple pregenital setae (fig. 1*b*). Accessory gland with long, slender duct and simple, membranous, spherical vesicle (fig. 1*n*).

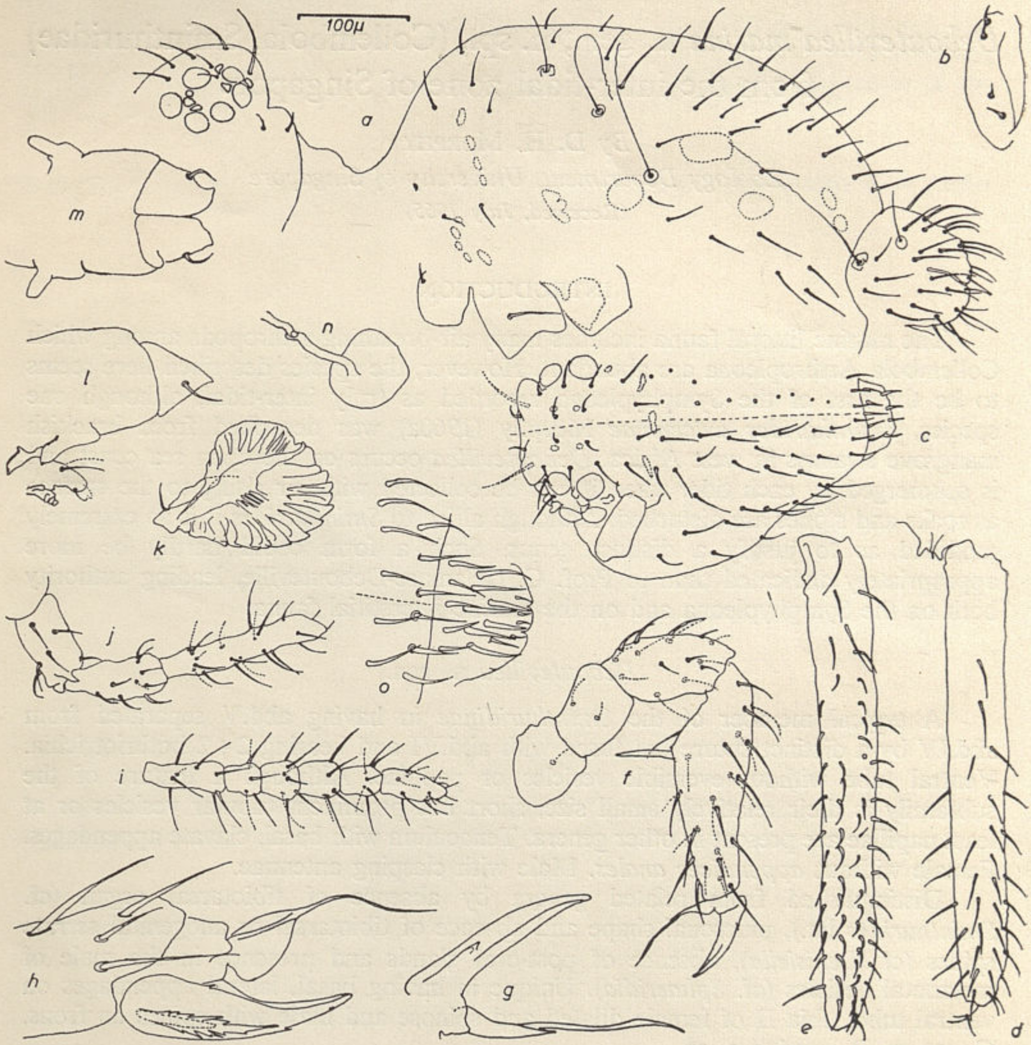

Figure 1. *Deboutevillea marina* female. *a* Occipital and body chaetotaxy, lateral view (x 1). *b* Pregenital setae (x 3.2). *c* Frontal chaetotaxy (x 1). *d* Dens, anterior (x 1.4). *e* Dens, posterior (x 1.4). *f* Leg II (x 1.4). *g* Claw I (x 3.2). *h* Claw III, posterior view (x 3.2). *i* Antenna IV (x 1.4). *j* Antenna I to III (x 1.4). *k* Mucro (x 1.4). *l* Ventral tube and tenaculum, lateral (x 1.4). *m* Ventral tube, anterior (x 1.4). *n* Accessory reproductive gland (x 3.2). *o* Clypeus (x 3.2). (All magnifications are relative to the scale in the figure.)

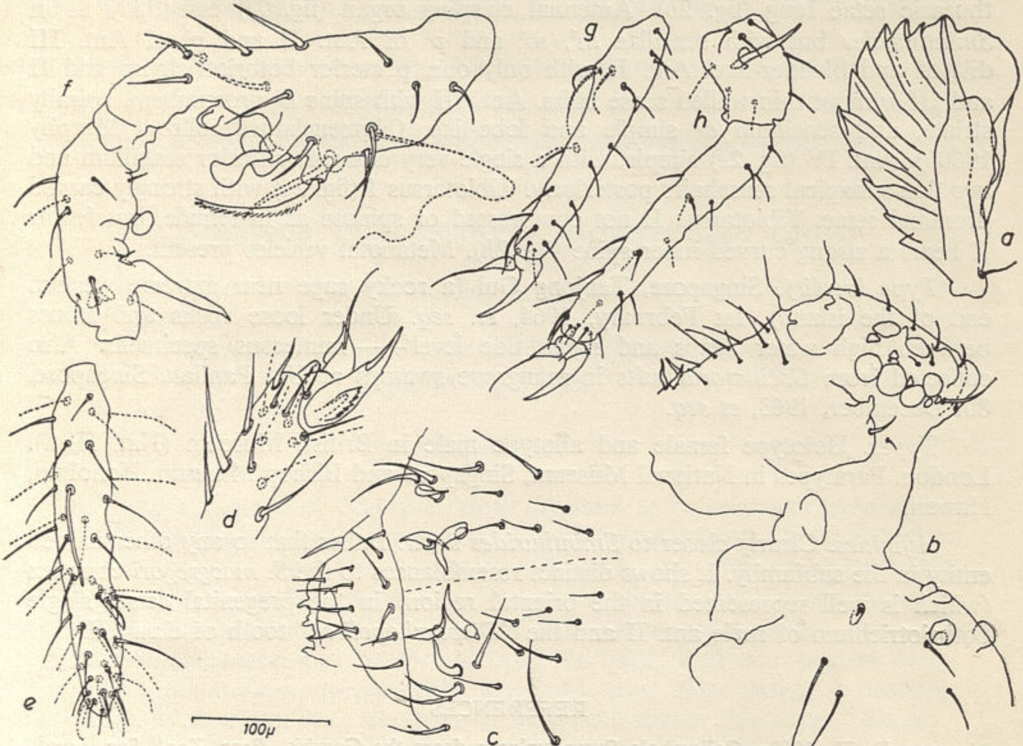

Figure 2. *Deboutevillea marina* male. *a* Mucro (x 2). *b* Head and thorax, lateral (x 1). *c* Clypeal spines (x 2). *d* Claw III and end of tibiotarsus, posterior view (x 2). *e* Antenna IV (x 2). *f* Antenna II + III (x 2). *g* Tibiotarsus and Claws of Leg I (x 1). *h* Femur, tibiotarsus and claws of leg II (x 1). (All magnifications are relative to the scale in the figure.)

Leg I with setae distributed as in male but not incurved. Claw I with 1 + 1 lateral and no inner teeth (fig. 1*g*). Leg II with tibiotarsus triangularly broadened and with strong internal spine (fig. 1*f*), but femur without spine. Claw II with 2+2 lateral and no inner teeth. Claw III (fig. 1*h*) with 2 teeth on anterior lamella, one on posterior lamella above which is a hollow, conical tooth-like process fringed with sharp teeth. (I was shown a similar process in *Disparrhopalites* by Dr. Delamare). No inner tooth. Empodial appendage simple. Tibiotarsus III with internal setae very strong but not serrate and no tibiotarsal organ. Trochanteral organ absent. Ventral tube as in figs. 1*l* & 1*m*. Dens (figs. 1*d* & 1*e*) long, straight and cylindrical with setae in 9 rows. Mucro (fig. 1*k*) much enlarged, almost one third length of dens, 0.8 as wide as long, obovate and strongly flexed inwards. Three lamellae, the inner with 15 to 20 imbricate teeth, outer broad and convolute but not folded into teeth, anterior reaching only half-way to apex. Mucronal seta present.

Male. Size up to 0.5 mm. Differs from female in presence of 3 + 3 spines above the clypeus, two of these hooked and one T-shaped on each side (fig. 2*c*). Head with strong tubercles behind the eyes and postocular setae unequal. Lateral thoracic setae long (fig. 2*b*). Antennal clasping organ (fig. 2*f*) essentially as in *Sminthurides* but with sensillae m^1, m^2 and p^1 of Ant. II and p^1 of Ant. III dilated and bladder-like. Ant. II with only one, posterior bothriotrichium and II and III without thin-walled sense hairs. Ant. III with spine d^1 procumbent, spirally striate, and sensillum d^2 simple and lobe-like. (Nomenclature follows Murphy 1960*b*). Ant. IV (fig. 2*e*) simple, with a single very elongate anterior sensillum and two fine subapical sensehairs posteriorly. Tibiotarsus I (fig. 2*g*) with strongly curved proximal setae. Tibiotarsus II not compressed or spinose as in female, but femur II bears a strong curved inner spine (fig. 2*h*). Metanotal vesicles present.

Type locality. Singapore, Tanjong Gul (a rocky cape near extreme western end of the island), 1st February, 1964, *et. seq*. Under loose rocks and stones between high water neaps and mean tide level —— numerous specimens. Also collected from *Oscillatoria* tufts in mangrove swamps at Ulu Pandan, Singapore, 8th December, 1963, *et seq*.

Types. Holotype female and allotype male in British Museum (Nat. Hist.), London. Paratypes in National Museum, Singapore and Bishop Museum, Honolulu, Hawaii.

Affinities. Clearly closer to *Sminthurides* s. str. rather that to any other named entity in the subfamily. It shows distinct resemblances to the *S. macgregori* complex (which is well represented in the oriental region) in the pregenital setae, single bothriotrichium of male ant. II and the "*Disparrhopalites*" tooth of claw III.

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No. 33 **November 30, 1965** **Part 7**

The Anatomy of *Calamaria multipunctata* (Boie)

By R. A. M. BERGMAN

Koninklijk Instituut voor de Tropen, Amsterdam

(*Received, April 1963*)

INTRODUCTION

The group *Calamaria* or *Changulia* does not seem to be very well defined. De Rooij (1917) describes 46 species, including 23 from Borneo; Smith (1943) describes only 3 species while de Haas (1941) mentions 68 species, of which nearly half (29) are from Borneo, 14 are from Java, 4 are from both islands and the rest from the other islands. It seems worthwhile to investigate this group more closely.

The name *Calamaria* may be derived from the Greek *Kalamos* (reed or flute) or from the Latin *Calamus* (a pen). The word may have been chosen to describe a morphological character, i.e., the snake is small and slender like a pen. Alternatively it may have been used to indicate an ecological particularity, i.e., the animal lives among reeds or bamboo. Boie (1827) does not give an explanation. The word *Changulia* has been used by Gray (1833–35) without comment. Prof. Kuiper, whom I thank for his kind help, informs me that there is a Hindi word in a Russian dictionary spelt "changuli", *changuliya,* meaning little finger. In other sources this word is written *chungliya, chinguli* or *chungli.* It seems quite possible that this word has been chosen to indicate that it is a small snake, as big as the little finger. Other derivations, from *cangul* (claw, talon) or from *congol* (grass) and *iya* (animal) would seem less probable. This snake has a short obtuse tail, ending in a pointed scale. When taken in the hand it wriggles, pushing this scale against the palm of the hand or between the fingers, making an impression more or less similar to that made by a bird's claw. The name would then mean, the snake with the claw or the claw-like end. The combination of grass and animal could indicate the mean habitat of the animal.

The local name in the western province of Java is *oraj surapari,* which in Sundanese, is translated as, a small poisonous snake with a red point at the end of the tail.

The description given by de Rooij (1917: 174) is very clear and in her illustration (fig. 67) the two extreme types are shown. The animals I have seen were more often uniformly dark on the back, with a few coloured spots. The lower surface was mostly red, with black quadrangular spots, the darker colour being predominant.[1]

[1] Boie describes *multipunctata* as "supra e cinero et purpurascenti pallida, subtus albida, tota maculis parvis subquadratis varia . . ."

TABLE 1

Calamaria multipunctata, maximum lengths in mm

	UNSEXED		MALES		FEMALES	
	Body	Tail	Body	Tail	Body	Tail
de Rooij, 1917 ..	305	15	..	..	..	..
Kopstein, 1941 ..	..	..	306	(33)	338	(17)
de Haas, 1941 ..	..	..	264	(26)	340	(17)
Bergman	..	..	253	(27)	358	18

TABLE 2

Calamaria multipunctata, length of body and tail of animals longer than 150 mm

Body Length	N	R	$M \pm \sigma_m$	σ	V
Males:					
Kopstein	17	159–306	222.5±9.2	37.9	16.8
de Haas	181	153–264	212.6±1.8	24.2	11.4
Bergman	67	164–253	211.4±2.4	19.4	9.2
Females:					
Kopstein	48	164–338	262.4±5.0	34.8	13.3
de Haas	191	160–340	260.4±2.9	40.5	15.5
Bergman	55	222–358	274.4±3.9	29.1	10.6
Tail Length					
Males:					
Kopstein	17	14– 33	22.5±1.1	4.4	19.5
de Haas	181	12– 26	20.2±0.2	2.7	13.4
Bergman	67	14– 27	21.2±1.0	2.7	12.5
Females:					
Kopstein	48	8– 17	13.1±0.3	2.0	15.4
de Haas	191	6– 17	11.9±0.2	2.3	19.3
Bergman	55	10– 18	13.0±0.2	1.8	13.5

MATERIALS AND METHODS

Most of our specimens came from the Bandjarwangi Estate in West Java, where Mr. de Haas, then superintendent, collected them from 1939 to 1942. They were put in small plywood boxes together with wet moss and survived the journey of some hundreds of kilometers to Surabaia very well. A few were captured near Surabaia. Altogether there were 83 males and 80 females.

The snakes were killed by occipital puncture, weighed and perfused through the aorta with isotonic saline followed for hardening by Bouin's liquid. Then the distances from snout to the top and the end of each organ were measured.

For statistical analysis the methods given by Simpson and Roe (1939) have been followed.

Furthermore, we have the data on the length of body and tail of 18 males and 48 females given by Kopstein (1941) and of 184 males, 191 females and 62 unsexed juveniles from de Haas (1941). In one of Kopstein's male specimens the tail is too short, but the sex is probably correct as the number of ventral scales indicates. In the list given by de Haas, three snakes listed as males (No. 776–834–2676) are grouped as females on account of their tail length. The measurements for these two series together with those of the group studied in Surabaia are given in Table 2.

PATHOLOGY

In my series I noted in 8 instances that the gallbladder was filled with a clear watery liquid. This occurred in three females with a body length of 175, 200 and 268 mm. respectively, and in five males, three of 148, 195, 200 and two of 217 mm. In Kopstein's list one male with a body length of 233 mm. is noted with a broken tail, a rare occurrence in these snakes.

SIZE

The maxima listed in the literature are summarized in Table 1. The figures in brackets do not refer to the animal whose body length is given. The figures for *Calamaria linnaei* (Boie) are taken from de Rooij (1917).

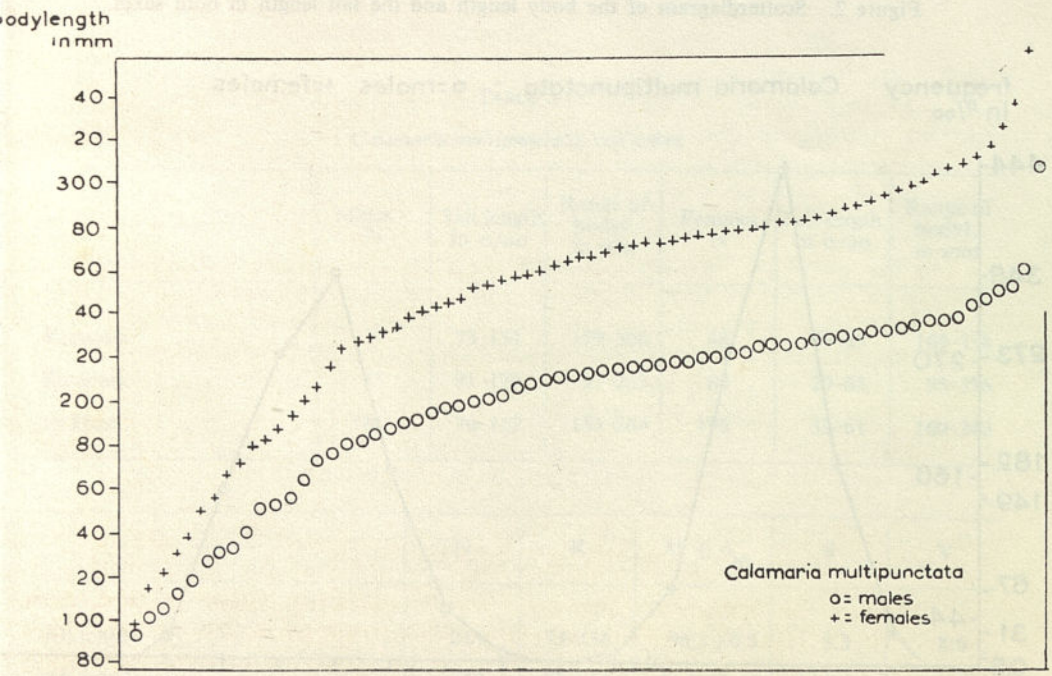

Figure 1. The series of body lengths in the male and female group.

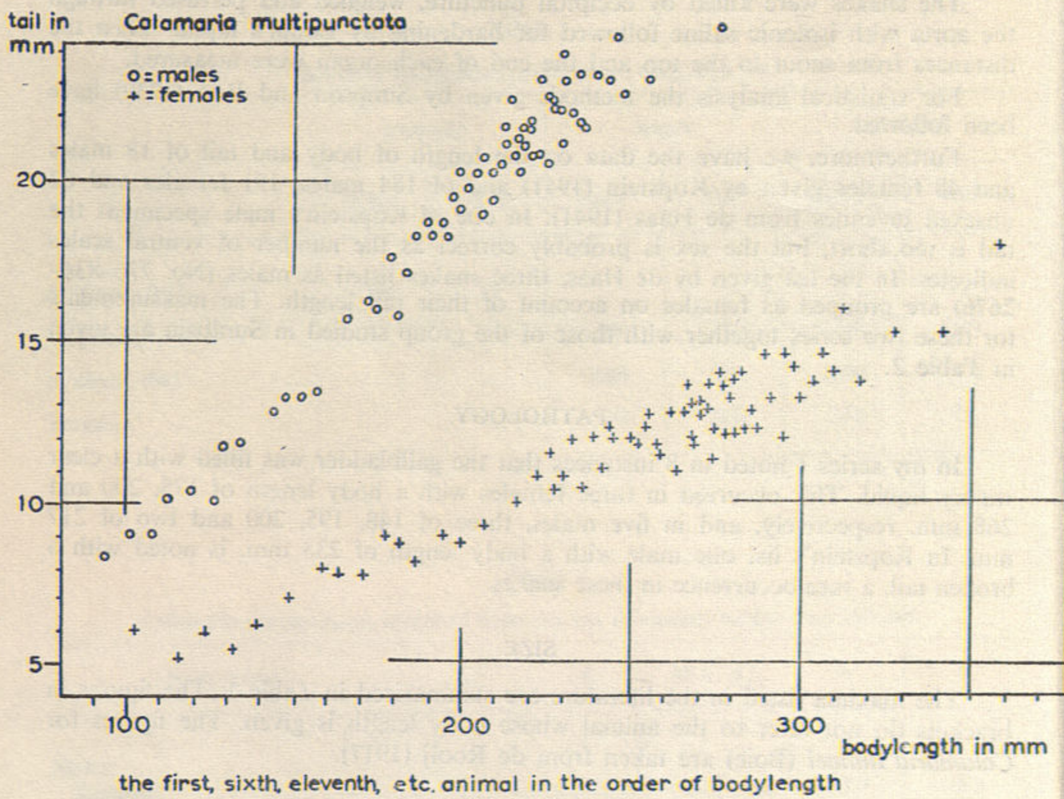

Figure 2. Scatterdiagram of the body length and the tail length in both sexes.

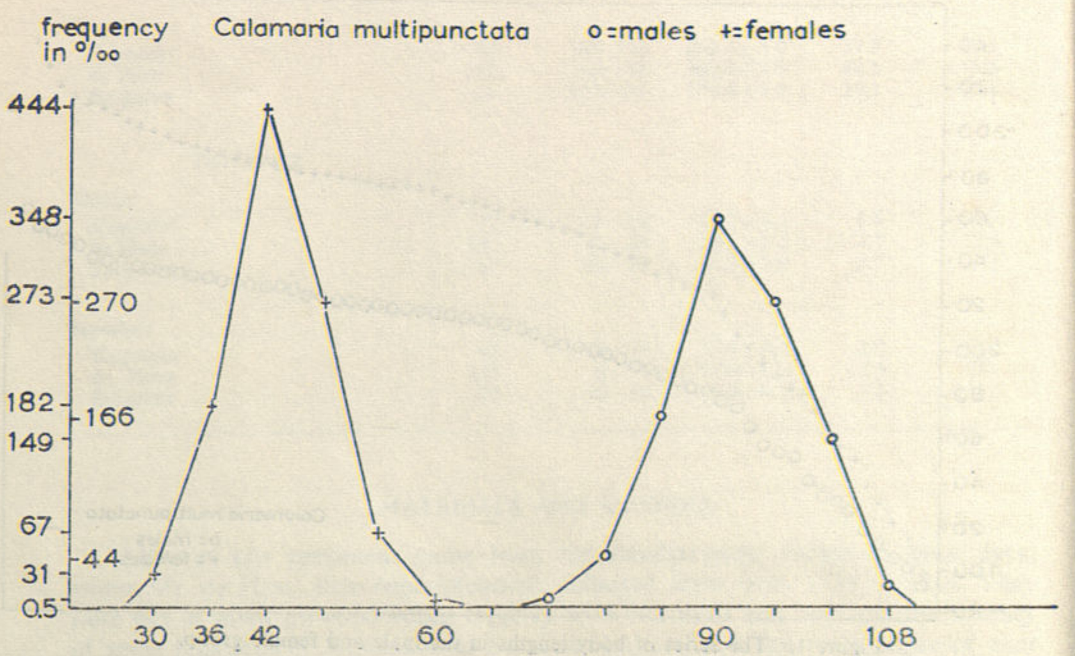

Figure 3. Frequency curve of the tail index in both sexes.

Sexual dimorphism in body length is obvious, the males being definitely shorter. In each of the three series the difference is statistically significant, $D/\delta D$ for Kopstein's animals is 3.8, for de Haas' series 14.0, and 13.7 for my series. This is also demonstrated when males and females are arranged in the order of length. The lines connecting the tops of the curve of Galton have the same pattern for the three collections. Figure 1 shows the line for all the material available: the first animal in each of the successive groups of five is entered. There is also sexual dimorphism in the length of the tail, which is longer in males than in females. This holds true in absolute values notwithstanding the fact that males are shorter as regards body length. The $D/\delta D$ quotient is 7.9 for Kopstein, 29 for de Haas, and 8 for my series. This dimorphism is even more obvious in the figures of the relative length of the tail: in males the tail is about 100% of the body length while in females it is a mere half, viz., 48%. Figure 2 shows the distribution of tail length and body length in the group. The frequency curve of the tail length expressed in o/oo of the body length is given in figure 3. The data for the three groups are given in Table 3. In the graph there is no overlapping of the frequency curves of both sexes. If, as the lower extreme value for the males, we take M minus three sigma, the result is 71.4, and the highest probable value in the female group being set at M plus three sigma, it is 65.1. The chance of obtaining the low value in a male specimen is slender: $96.3 - 65 = 3.78$, or less than one in ten thousand, and the chance of obtaining a female with a tail index of 73 is of the order of one in thirty thousand: $\dfrac{46.8 - 71}{6.1} = 3.98$ The correlation between these characteristics for the three sets of data is shown in Table 4 as far as the coefficients r and Z concerned, while the full data is given in Table 10.

TABLE 3

Calamaria multipunctata, tail index

——	Males N	Tail length in o/oo	Range of bodyl. in mm	Females N	Tail length in o/oo	Range of bodyl. in mm
Kopstein	17	73–134	159–306	48	39–63	164–338
Surabaia	83	81–120	97–253	80	29–65	95–376
de Haas	181	76–112	153–264	195	32–61	160–340

——	N	R	$M \pm \sigma_m$	σ	V
All males	281	73–134	96.3±0.5	8.3	8.6
All females	323	29– 65	46.8±0.34	6.1	13.0

TABLE 4

Calamaria multipunctata, correlation coefficient between the length of body and tail

	MALES		FEMALES	
	r	$Z \pm \sigma_Z$	r	$Z \pm \sigma_Z$
Kopstein	0.578	0.65±0.27	0.673	0.81±0.14
de Haas	0.793	1.05±0.07	0.804	1.08±0.07
Bergman	0.795	1.05±0.12	0.507	0.55±0.14

TABLE 5

Calamaria multipunctata, the length of the tail in various length (age) groups

MALES				FEMALES			
N	M body in mm	M tail in mm	o/oo	N	M body in mm	M tail in mm	o/oo
20	106	9.2	86	23	128	5.7	44
19	136	11.5	84	32	193	8.5	44
34	177	16.2	92	32	240	10.8	45
36	201	18.9	95	32	261	11.7	45
38	215	21.0	97	32	274	12.3	45
37	226	21.6	96	32	287	13.3	47
36	246	22.6	92	32	310	14.3	46

In the group of "juvenile" animals, de Haas counted 62 snakes measuring from 90 to 150 mm. in body length. On the assumption that the animals with an index lower than 60 are females, and that the animals with a tail longer than 60% of the body length are males, there would be one group of 23 females and another of 39 males. In the group measuring 90 to 120 mm. the number of males is 19, while the females number 9; in the group of the longer animals, i.e., between 120 and 150 mm., the number of males is 20 and the number of females 14, so the females would seem to be more frequent in the longer group. The average values for the "male" category are 121 mm. body length and 10.3 mm. tail length and for the "female" group 125 mm. and 5.7 mm. respectively. In the group examined in Surabaia, 8 females and 14 males are shorter than 153 mm. and the averages for "males" are 129 and 11.8 mm., and for "females" 125 mm. and 6.1 mm. respectively. The figures for all the "males" under 153 mm. of body length are N = 53, M body length = 123, and M tail length = 10.7 (87 in o/oo; for all the "females" shorter than 153 mm., N = 31, M body length = 127, M tail length = 5.8 (45 o/oo).

Another question is whether the relation between the lengths of the body and the tail remains constant throughout the whole span of life. The animals may be divided into groups of increasing lengths, as is done in Table 5 for de Haas' series. The figures for the group examined in Surabaia show the same relations. It seems that in the females the relation tail length — body length is constant throughout the life span, the differences between the consecutive indices of the length of the tail amounting to only one or two points. In males it is not very clear. There may be a certain progression of the tail length with the onset of maturation; between the group measuring 136 mm. body length and that of 177 mm., the indices differ 8 points. For all the other classes this difference is 2 and 3.

SEX RATIO

The numbers of males and females in the three series are given in Table 2. There is no suggestion of a deviation from the 1: 1 ratio, although Kopstein recorded a greater number of female animals.

MATURITY

For the females, the first bend in the line of the successive body lengths occurs a little above the 230 mm. mark in Kopstein's series, while it lies between 230 and 240 mm. in both de Haas' and our series. In the data given by de Haas, we find that the smallest female carrying eggs has a body length of 239 mm., while in our series the smallest at this stage measures 243 mm. It is suggested that this is about the stage marking the transition from the juvenile to the adult. Regarding the males, no histological examination of the testes was made. If we take the bend in the curve of Galton to be a symptom, the length of attaining maturity would be around 160 mm. This figure was used in the statistical analysis of the data on the topography of the organ pattern.

FERTILITY

The data collected by de Haas shows that pregnant animals are found throughout the year and amount to about two-thirds of the catches. The 124 females carried from one to five eggs, usually three or two, the average number (Table 6) being 2.8. The list also suggests an increase in fertility commensurate with increase in age, the latter as indicated by the length of the body. The average number of eggs increases from 1.5 to 3.4 per length class as shown in the same table.

TABLE 6

Calamaria multipunctata, numbers of eggs

de Haas			Body length in mm	Bergman				
Snakes	Eggs	p. cap		Snakes	R	L	Total	p. cap
2	3	1.5	215/234	..	..	..	..	..
30	64	2.1	240/264	3	3	3	6	2.–
53	144	2.7	265/289	9	13	6	19	2.1
32	99	3.1	290/314	3	4	2	6	2.–
7	24	3.4	315/339	2	3	2	5	2.5
..	..	..	340/364	2	3	2	5	2.5
124	334	2.8		19	26	15	41	2.2

My own series includes 19 pregnant females, this being about a third of the females with lengths exceeding 200 mm. These numbers are however too small to be significant, but they are in accordance with the others. Furthermore, in Surabaia we checked the repartition of the eggs in both uterine tubes; out of a total of 41 eggs we found 26 on the right side and 15 on the left. The range is from 1 to 4 per animal, the average being 2.5.

Table 7 shows the frequency in the monthly catches in the collection of de Haas, tabulating for all the animals, including the juveniles, and for the males and the females separately. The lines are somewhat irregular, with two low points, one in February and one in November, and two peaks, one in March and one in August. To smoothen out the curve we may use a less subtle division, e.g., into periods of two months. The data expressed in o/oo for the male and the female group, are given in Table 8.

TABLE 7

Calamaria multipunctata (coll. de Haas), number of animals caught per month

——	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
All ..	47	26	62	46	31	42	32	57	13	26	17	37
♂ ..	16	13	29	13	22	18	11	24	12	13	6	14
♀ ..	19	9	25	18	12	19	19	20	14	11	6	11

TABLE 8

Calamaria multipunctata (coll. de Haas), frequency of bimonthly catches in o/oo of the total

——	Jan.–Feb.	Mar.–Apr.	May–June	July–Aug.	Sept.–Oct.	Nov.–Dec.	Total
♂ ..	152	220	210	183	131	105	1,001
♀ ..	153	235	169	214	137	93	1,001

TABLE 9

Calamaria multipunctata (coll. de Haas), number of juveniles per 2 months

——	Dec.–Jan.	Feb.–Mar.	April–May	June–July	Aug.–Sept.	Oct.–Nov.
High tail index ..	6	..	..	2	2	..
Low tail index ..	3	2	..	..	2	1
Total ..	9	2	..	2	4	1

The curve for the males shows one peak and one low point, while that for the females follows the same course with one additional peak; in other words, the frequencies for both sexes correspond, except in May/June when more males are caught and July/August when more females are caught. In o/oo of the total catch, the one in May/June equals 210 o/oo of the males and 169 o/oo of the females, and in July/August 183 o/oo of the males and 214 o/oo of the females (fig. 4). This may be an indication that there is a periodicity in mating, with the males coming out into the open first and the females following a little later. The dates of birth may be derived from the time when the smallest animals are caught. The smallest ones with a high tail index were caught in January (90, 91, 98, 101, & 102 mm.), June (98 mm.), July (92 mm.), August (100 mm.), September (103 mm.), and December (101 mm.), i.e. six in December/January, and four from June to September. The smallest ones with a low tail index were caught in January (116 mm.), February (118 mm.), March (96 mm.), August (109 & 112 mm.), October (115 mm.), and December (110 & 115 mm.), i.e. three in December/January, two in February/ March, and seven from June to October (Table 9). There is a peak in December/ January, a decline in April/May and another peak in August/September.

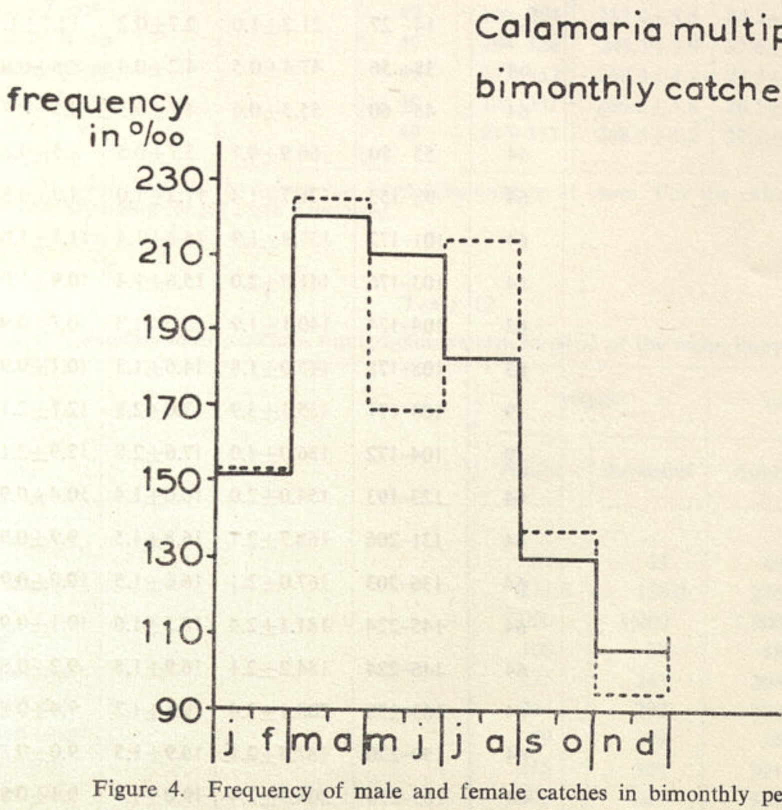

Figure 4. Frequency of male and female catches in bimonthly periods.

TOPOGRAPHY

As there is definite sexual dimorphism in the length of the body, a corresponding difference will be found in every topographical measurement. These data are given in the Tables 10 and 11. We may get a better insight into the length of the organs and their topography when we compare the relative values of the data projected upon the body length (Table 12). The same data are elaborated on a scale map (fig. 5) for juvenile and adult animals, for both males and females. The differences between the juvenile animals of both sexes are very small indeed. In the adults however, there is some difference; the organs of the cranial half of the body are situated somewhat more cranially in females, and the kidneys seem to be located more caudally in the same group. The data on the spleen cannot be compared with those on the pancreas, since it was measured in only 19 cases out of 63. When the data for the pancreas are taken for the same group as that of which the spleen was measured, the top of the spleen proves to be practically on the same level as the top of the pancreas.

TABLE 10

Calamaria multipunctata, males, distances from the snout to the top and the end of the organs

——	N	R	$M \pm \sigma_m$	$\sigma \pm \sigma_\sigma$	$V \pm \sigma_v$
Body length	68	164–253	211.8±2.4	19.5±1.7	9.2±0.8
Tail length	68	14– 27	21.2±1.0	2.7±0.2	12.5±1.1
Heart top	64	38– 56	47.4±0.5	4.2±0.4	8.8±0.8
Heart end	64	45– 60	55.5±0.6	4.7±0.5	8.5±0.7
Liver top	64	55– 80	66.9±0.7	5.7±0.5	8.5±0.8
Liver end	64	98–153	126.7±1.4	11.2±1.0	8.9±0.8
Gallbladder top	64	101–172	137.9±1.9	15.3±1.4	11.1±1.0
Gallbladder end	64	103–176	141.9±2.0	15.6±1.4	10.9±1.0
Pancreas top	63	104–174	140.1±1.9	15.0±1.3	10.7±0.9
Pancreas end	63	108–178	145.0±1.8	14.6±1.3	10.1±0.9
Spleen top*	19	103–171	135.1±3.9	17.0±2.8	12.7±2.1
Spleen end	19	104–172	136.0±4.0	17.6±2.8	12.9±2.1
Testes R top	64	123–193	154.0±2.0	16.0±1.4	10.4±0.9
Testes R end	64	131–206	168.7±2.1	16.8±1.5	9.9±0.9
Testes L top	64	136–203	167.0±2.1	16.6±1.5	10.0±0.9
Testes L end	64	145–224	181.1±2.4	18.3±1.6	10.1±0.9
Kidney R top	64	146–224	184.2±2.1	16.9±1.5	9.2±0.8
Kidney R end	64	163–250	208.1±2.4	19.6±1.7	9.4±0.8
Kidney L top	64	150–220	187.5±2.1	16.9±1.5	9.0±0.8
Kidney L end	64	163–250	208.1±2.4	19.0±1.7	9.1±0.8

*In adult males the spleen has been measured in only 19 cases.

TABLE 11

Calamaria multipunctata, females, distances from the snout to the top and the end of the organs

——	N	R	$M \pm \sigma_m$	$\sigma \pm \sigma_\sigma$	$V \pm \sigma_V$
Body length	45	222–358	274.0±4.0	29.1±2.8	10.6±1.0
Tail length	55	10– 18	13.0±0.2	1.8±0.2	13.8±1.3
Heart top	49	44– 71	55.9±0.8	5.6±0.6	10.0±1.0
Heart end	49	51– 82	65.3±0.9	6.4±0.6	9.8±1.0
Liver top	49	63– 99	79.7±1.2	8.2±0.8	10.2±1.0
Liver end	49	127–205	159.0±2.4	16.5±1.7	10.4±1.1
Gallbladder top	49	140–230	177.8±2.7	19.1±2.0	10.7±1.1
Gallbladder end	49	145–235	181.8±2.9	20.0±2.0	11.0±1.1
Pancreas top	49	143–232	180.2±2.9	20.2±2.0	11.2±1.1
Pancreas end	49	148–238	186.2±2.8	19.9±2.0	10.6±1.1
Spleen top*	21	145–232	187.4±4.8	22.0±3.4	11.7±1.8
Spleen end	21	146–234	189.0±4.7	21.6±3.3	11.4±1.8
Ovary R top	49	161–255	195.4±3.0	20.8±2.1	10.6±1.1
Ovary R end	49	173–276	213.8±3.3	23.3±2.4	10.9±1.1
Ovary L top	49	181–277	218.4±3.1	21.4±2.2	9.8±1.0
Ovary L end	49	188–294	232.4±3.5	24.3±2.5	10.4±1.1
Kidney R top	49	194–328	243.3±3.9	27.6±2.8	11.3±1.1
Kidney R end	49	212–352	268.3±4.2	29.3±3.0	10.9±1.2
Kidney L top	49	198–331	246.2±3.8	26.5±2.7	10.7±1.1
Kidney L end	49	215–352	268.5±4.2	29.4±3.0	10.9±1.1

* In adult females the spleen has been measured in 21 cases. For the calculation of o/oo the corresponding length have been used.

TABLE 12

Calamaria multipunctata, topographic pattern in o/oo of the mean body length

——	MALES		FEMALES	
	Adults	Juveniles	Adults	Juveniles
N	64	11	49	23
M Body	211.8	138.0	274.0	166.2
Body	1,000	1,000	1,000	1,000
Tail	100	92	48	49
Heart top	225	243	204	231
Heart end	264	292	238	268
Heart length	39	49	34	37
Liver top	318	348	291	326
Liver end	602	647	579	621
Liver length	284	299	289	295

TABLE 12 — *continued*

Calamaria multipunctata, topographic pattern in o/oo of the mean body length

	MALES		FEMALES	
	Adults	Juveniles	Adults	Juveniles
Gallbl. top	655	706	649	691
Gallbl. end	684	725	663	710
Gallbl. length	18	20	16	18
Pancreas top	664	717	657	666
Pancreas end	685	738	678	685
Pancreas length	22	20	21	19
Spleen top	634	..	663	..
Spleen end	640	..	668	..
Spleen length	6	..	5	..
Sex R top	730	793	714	790
Sex R end	799	844	779	828
Sex R length	69	51	66	38
Sex L top	796	844	798	850
Sex L end	860	893	848	879
Sex L length	63	49	50	28
Both gonads	132	100	116	66
Kidney R top	878	910	890	890
Kidney R end	984	1,010	980	990
Kidney R length	108	100	90	101
Kidney L top	893	925	900	906
Kidney L end	986	1,010	980	990
Kidney L length	94	85	78	85
Both kidneys	202	183	169	186
Weight	26.4	12.3	29.4	14.5

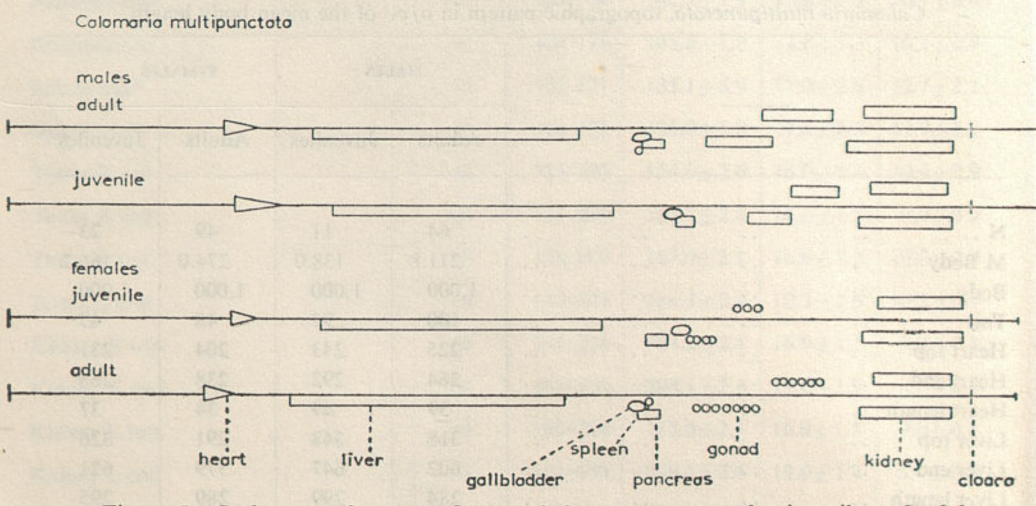

Figure 5. Scale map of average figures of the organ pattern for juvenile and adult specimens in both sexes.

LENGTH

The data on lengths in mm. are given in Table 13. There are very few differences in the relative length of the organs. However, contrary to what we would expect, the gonads are somewhat longer in males. In addition, the kidneys are also somewhat longer in males, amounting to 200 o/oo of the body length, whereas in females they measure only 170 o/oo of the body length. In both sexes there is asymmetry, the gonads and the kidneys being shorter on the left side than on the right.

TABLE 13

Calamaria multipunctata, lengths of the organs in mm

	N	R	$M \pm \sigma_m$	$\sigma \pm \sigma_\sigma$	$V \pm \sigma_v$
	MALES				
Body length	68	164–253	211.8±2.4	19.5±1.7	9.2±0.8
Tail length	68	14– 27	21.2±0.3	2.7±0.2	12.6±1.1
Heart	64	5– 11	8.1±0.2	1.3±0.1	15.9±1.4
Liver	64	42– 75	59.8±1.0	7.7±0.7	12.9±1.1
Gallbladder	64	2– 6	3.8±0.1	0.9±0.1	25.0±2.2
Pancreas	63	2– 9	4.7±0.2	1.5±0.1	32.0±3.0
Spleen	19	1– 4	1.3±0.2	1.0±0.1	72.0±11.6
Testes R	64	8– 21	14.6±0.4	2.8±0.3	19.7±1.7
Testes L	64	6– 23	13.5±0.4	3.3±0.3	24.7±2.2
R + L	64	15– 41	27.9±0.6	5.0±0.4	18.0±1.6
Kidney R	64	14– 35	22.9±0.5	4.3±0.4	21.7±1.9
Kidney L	64	11– 29	19.8±0.3	3.9±0.4	21.0±1.9
R + L	64	26– 64	42.6±0.9	7.3±0.7	17.6±1.6
Weight	67	2– 9	5.6±0.2	1.6±0.1	25.4±2.2
	FEMALES				
Body length	55	222–358	274.0±4.0	29.1±2.8	10.6±1.0
Tail length	55	10– 18	13.0±0.2	1.8±0.2	13.8±1.3
Heart	49	6– 13	9.3±0.2	1.7±0.2	17.7±1.8
Liver	49	60–106	79.3±1.5	10.5±1.1	13.2±1.3
Gallbladder	49	2– 6	4.3±0.1	1.0±0.1	21.5±2.2
Pancreas	49	2– 3	5.7±0.2	1.2±0.1	22.2±2.2
Spleen	21	1– 3	1.3±0.1	0.5±0.1	74.3±11.4
Ovary R	49	6– 41	18.1±0.8	7.8±0.8	42.9±4.3
Ovary L	49	5– 25	13.8±0.7	5.2±0.5	38.5±3.9
R + L	49	16– 66	31.8±1.6	11.0±1.1	34.9±3.5
Kidney R	49	6– 36	24.6±0.7	4.9±0.5	19.9±2.0
Kidney L	49	5– 31	21.5±0.7	4.3±0.4	20.0±2.0
R + L	49	11– 67	46.3±1.3	9.3±0.9	20.1±2.0
Weight	55	4– 16	8.1±0.3	2.5±0.2	30.1±2.9

INTERVALS

The average values for the intervals between the organs are, as expected, smaller in males. Table 15 shows these values expressed in o/oo of the mean body length.

TABLE 14

Calamaria multipunctata, intervals between the organs in mm

	N	R	M ± ó$_{m}$	ó ± ó$_{ó}$	V ± ó$_{v}$
	MALES				
A1 snout-heart	49	44– 71	55.9±0.8	5.6±0.6	10.0±1.0
A2 heart-liver	49	7– 21	14.4±0.5	3.6±0.4	25.0±2.5
A3 liver-gallbladder	49	2– 41	19.0±1.6	11.6±1.1	58.0±5.8
A	49	70– 11	89.5±1.6	11.3±1.1	12.7±1.3
B1 pancreas-gonad R	49	1– 21	9.5±0.8	5.4±0.5	57.0±5.7
B2 gonad-kidney R	49	5– 74	29.4±2.5	17.6±1.8	60.0±6.0
B3 kidney-cloaca R	49	0– 24	6.2±0.5	3.7±0.4	59.7±6.0
B	49	17– 88	45.7±2.4	16.9±1.7	37.0±3.7
C1 pancreas-gonad L	49	14– 58	32.4±1.6	11.3±1.1	34.9±3.5
C2 gonad-kidney L	49	1– 38	14.6±1.5	10.3±1.0	70.5±7.1
C3 kidney-cloaca L	49	0–13	5.8±0.3	2.4±0.2	42.9±4.3
C	49	25– 97	52.9±2.5	17.7±1.8	33.4±3.4
A + B	49	111–177	135.4±2.3	15.8±1.6	11.6±1.2
A + C	49	119–196	143.0±2.5	17.5±1.8	12.2±1.3
DR pancreas-kidney R	49	24–110	57.4±2.8	19.5±1.9	33.9±3.5
DL pancreas-kidney L	49	28–113	61.4±2.8	19.8±2.0	32.3±3.2
	FEMALES				
A1 snout-heart	64	38– 56	47.3±0.5	4.1±0.4	8.7±0.8
A2 heart-liver	64	7– 22	11.5±0.4	2.9±0.3	24.8±2.5
A3 liver-gallbladder	64	1– 29	11.2±0.9	7.1±0.6	63.8±5.5
A	64	51– 98	70.1±1.3	10.1±0.9	14.4±1.3
B1 pancreas-gonad R	63	2– 18	9.8±0.5	4.1±0.4	41.6±3.6
B2 gonad-kidney R	64	5– 28	16.2±0.8	6.0±0.5	37.0±3.3
B3 kidney-cloaca R	64	0– 6	3.3±0.2	1.3±0.1	38.4±3.4
B	63	10– 45	29.2±1.1	8.5±0.8	29.2±2.6
C1 pancreas-gonad L	63	9– 34	23.3±0.8	6.2±0.6	26.2±2.3
C2 gonad-kidney L	64	2– 17	7.2±0.7	5.3±0.5	72.7±6.4
C3 kidney-cloaca L	64	1– 5	3.0±0.1	1.0±0.1	33.6±2.9
C	63	17– 49	33.4±1.1	8.7±0.8	25.6±2.3
A + B	63	72–132	99.5±1.5	11.5±1.0	11.5±1.0
A + C	63	79–140	103.6±1.3	10.7±1.0	10.4±0.9
DR pancreas-kidney R	63	18– 61	41.1±1.2	9.4±0.8	22.9±2.0
DL pancreas-kidney L	63	23– 65	43.6±1.2	9.9±0.9	22.7±2.0

TABLE 15

Calamaria multipunctata, length of the intervals in o/oo of the body length

Interval	Males	Females
A1	224	204
A2	54	52
A3	53	69
B1	46	35
B2	77	107
B3	16	23
C1	110	118
C2	34	53
C3	14	21
A	332	326
B	138	167
C	158	193
A+B	470	494
A+C	490	522
DR	194	210
DL	206	224

The sum total of the spaces between the organs on both sides is longer in females. When measured on the right side (AB) this length is 470 o/oo of the body length in males and 494 o/oo of the body length in females. On the left side (AC) it is 490 o/oo in males and 522 o/oo in females. The differences amount to 24 o/oo on the right side and 32 o/oo on the left. In the region cranially from the pancreas, the space is perhaps a little longer in males, viz, 332 o/oo, whereas in females it is 326 o/oo, the difference being 6 o/oo. Caudally from the pancreas on the right side, these figures are 138 in males and 167 in females, with a difference of 29 o/oo, while on the left side they are 158 and 193 respectively, with a difference of 35 o/oo. The main local differences are found in the intervals B2 and C2 from the gonad to the kidney. The spaces on the right (B) and left (C) are longer in female animals, mainly because of the shorter kidney. B2 is 77 in males and 107 in females, a difference of 30 o/oo; C2 is 34 in males and 53 in females, so that on the left side the difference amounts to 19 o/oo. Perhaps the most important points, when considering the space available for growth of the eggs, are the end of the pancreas and the top of the kidney, although the topography of the complex pancreas-gallbladder-spleen seems less rigidly fixed than the liver.

VARIABILITY

As regards the topographic data, the variability is not very great. V ranges in both sexes between 8.5 and 11.7. For the length of the various organs, there is on one hand the heart, the liver, the kidneys, the right testes and the sum of both the testes in which V varies between 12 and 20. On the other hand, for the length of the gallbladder, the pancreas, the left testes and the ovaries, V increases from 20 to 43. Only for the spleen does the value of V seem excessively high, which no doubt must be attributed to the smallness of the organ and also to the scarcity of available data.

When considering the total amount of "free spaces" of intervals both on the right and left side, we find in both sexes an identical variability which is valid not only for the values A + B and A + C, but also for the sum of the intervals in the cranial half of the body A. This is also true for the space between the heart and the liver A2, for the interval between the liver and the gallbladder A3, and for the interval C3 between the left gonad and the kidney. However, for A1, A, AB and AC the coefficient V ranges between 9 and 14; for A2 it is 25, and for A3 and C2 around 60 and 70. For all other intervals the coefficient of variability is higher in females, although the quotient $D/\delta D$ is higher than 2.50 in only 4 instances, viz., for the intervals B2 and B3, for the spaces between the gonad and the kidney, and between the kidney and the cloaca. B2 has a high coefficient and $D/\delta D = 3.1$. For the intervals from the pancreas to the kidney the coefficients are of the order of 23 and 34, with $D/\delta D = 2.54$ for the right side and $D/\delta D = 2.51$ for the left side.

CORRELATIONS

The correlation between body length and tail length has been discussed above. The figures on these and other correlations are given in Table 16. In Figure 6 the weight is given in respect of the body length. In males r = 0.783, and in females r = 0.840, or $Z = 1.03 \pm 0.12$ and 1.23 ± 0.14, respectively. The average weight of the males is 5.6 ± 0.2 and that of the females 8.1 ± 0.4, $D/\delta D$ being 5.6, a very significant difference. When the greater body length of the female animals is taken into account, the difference diminishes although it does not disappear altogether. In males the weight is 26.4 o/oo, while in females 29.4 o/oo.

TABLE 16

Calamaria multipunctata, correlations

	MALES					
	N	R	$M \pm \sigma_m$	σ	V	$\overset{r}{Z} \pm \sigma_z$
Body (Kopstein) ..	17	159–306	222.5±9.2	37.9	16.8	r = 0.578
Tail	17	14– 33	22.5±1.1	4.4	19.5	Z = 0.66±0.27
Body (de Haas) ..	181	153–264	212.6±1.8	24.2	11.4	r = 0.793
Tail	181	12– 26	20.2±0.2	2.7	13.4	Z =1.08±0.07
Body (Surabaia) ..	68	164–253	211.8±2.4	19.5	9.2	r = 0.795
Tail	68	14– 27	21.2=1.0	2.7	12.5	Z =1.08±0.12
Body	49	222–358	273.2±4.4	30.7	11.2	r = 0.628
Gonads	49	16– 66	31.5±1.6	11.0	34.9	Z =0.75±0.15
Body	49	222–358	273.2±4.4	30.7	11.2	r = 0.440
Kidneys ..	49	11– 67	46.3±1.3	9.3	20.1	Z =0.47±0.15
Body	67	164–253	211.4±2.4	19.4	9.2	r = 0.783
Weight	67	2– 9	5.6±0.2	1.6	30.4	Z =1.03±0.12

TABLE 16 — *continued*

Calamaria multipunctata, correlations

—	FEMALES					
	N	R	$M \pm \acute{o}_m$	ó	V	r $Z \pm \acute{o}_z$
Body	48	164–338	262.4±5.0	34.8	13.3	r =0.673
Tail	48	8– 17	13.1±0.3	2.0	15.4	Z =0.83±0.14
Body (de Haas) ..	191	160–340	260.4±2.9	40.5	15.5	r =0.804
Tail	191	6– 17	11.9±0.2	2.3	19.3	Z =1.08±0.07
Body (Surabaia) ..	55	222–358	274.0±3.9	29.1	10.6	r =0.507
Tail	55	10– 18	13.0±0.2	1.8	13.5	Z =0.55±0.14
Body	64	164–253	211.4±2.4	19.4	9.2	r =0.615
Gonads	64	15– 41	27.9±0.6	5.1	18.3	Z =0.73±0.13
Body	64	164–253	211.4±2.4	19.4	9.2	r =0.510
Kidneys ..	64	26– 64	42.5±0.9	7.4	17.5	Z =0.57±0.13
Body	55	222–358	274.0±3.9	29.1	10.6	r =0.840
Weight	55	4– 16	8.1±0.4	2.5	30.5	Z =1.23±0.14

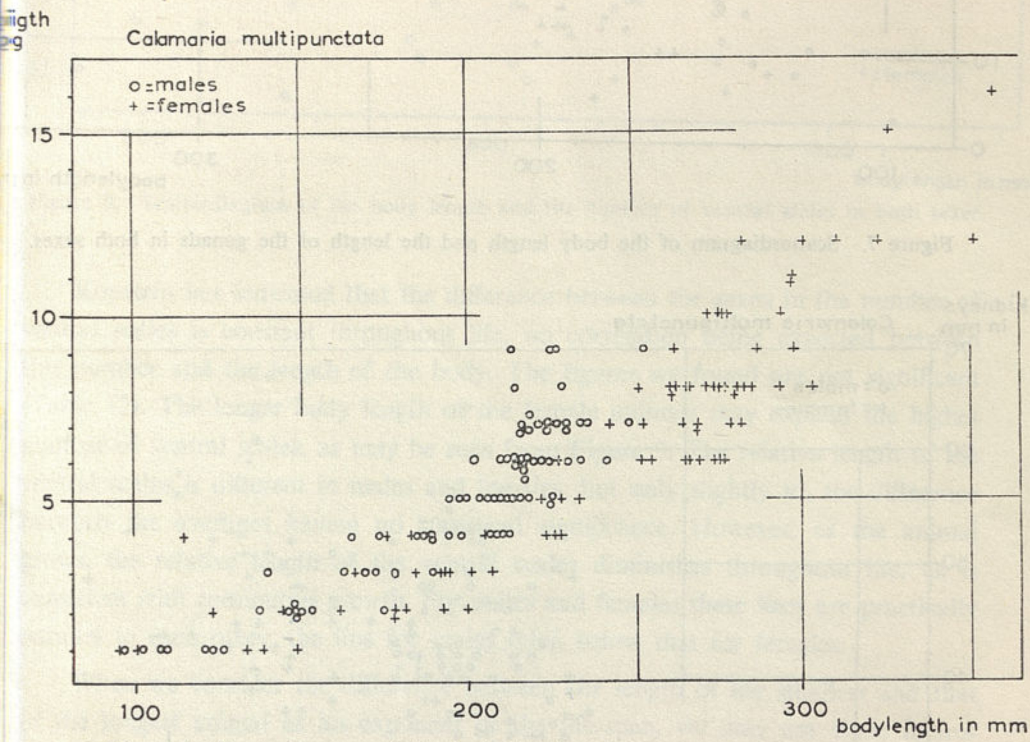

Figure 6. Scatterdiagram of the body length and the weight in both sexes.

Regarding the correlation between body length and the length of the gonads r = 0.615 in males and 0.628 in females, or Z = 0.72 ± 0.13 in males and 0.75 ± 0.15 in females (fig.7).

Between the length of the body and the length of the two kidneys r is 0.510 and Z = 0.57 ± 0.13 for males, while for females r is 0.440 and Z = 0.47 ± 0.15. In the case of the kidneys the correlation is rather low.

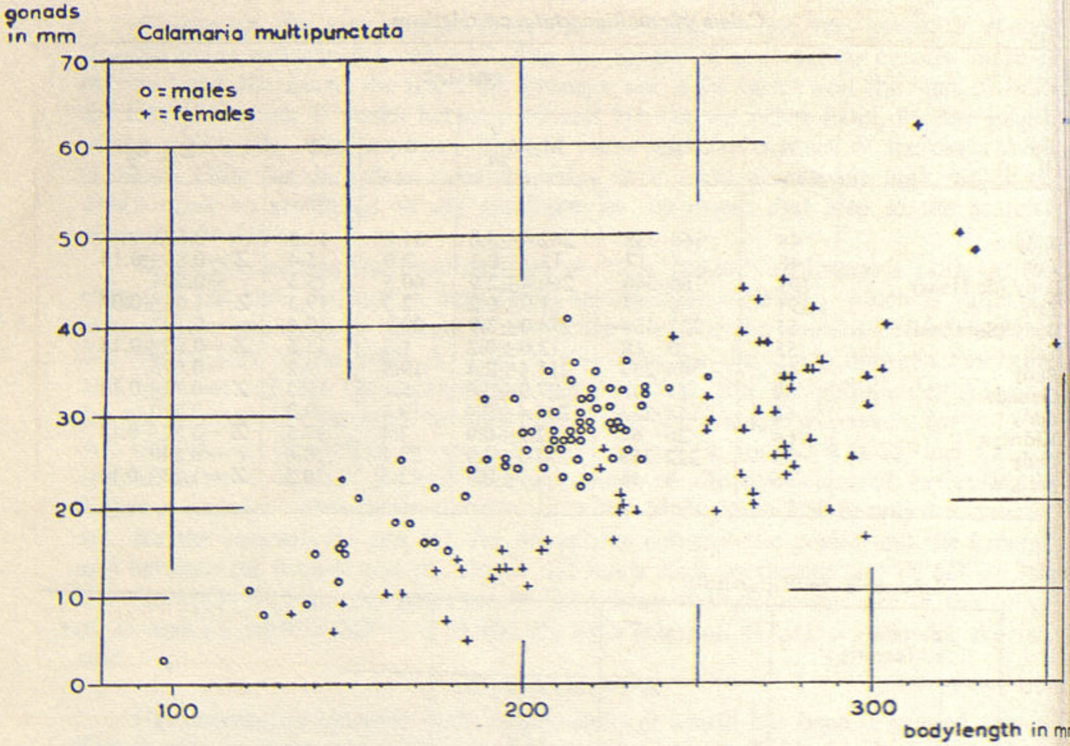

Figure 7. Scatterdiagram of the body length and the length of the gonads in both sexes.

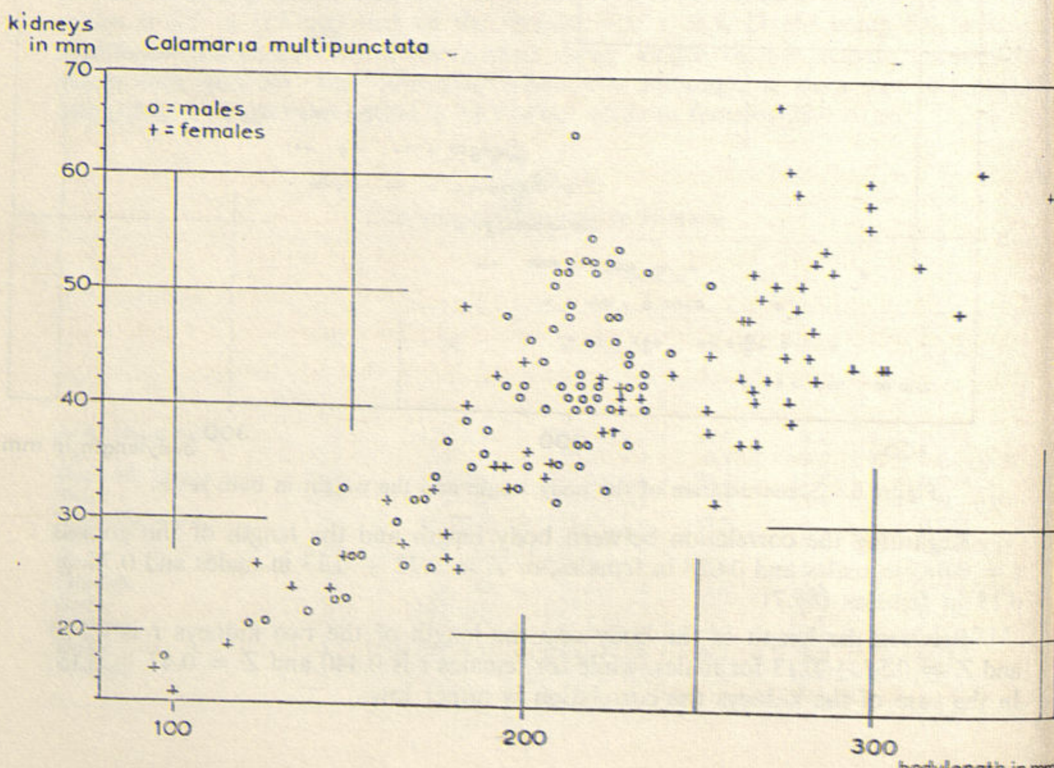

Figure 8. Scatterdiagram of the body length and the length of the kidneys in both sexes.

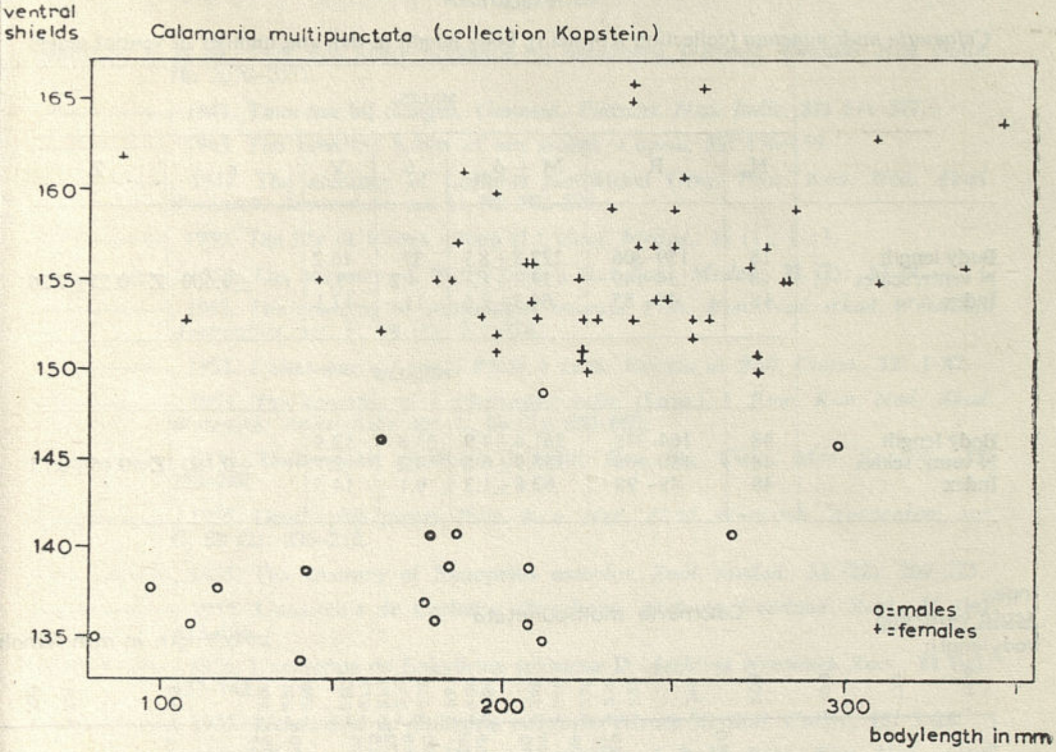

Figure 9. Scatterdiagram of the body length and the number of ventral scales in both sexes.

Kopstein has indicated that the difference between the sexes in the number of ventral scales is constant throughout life, no correlation being expected between this number and the length of the body. The figures we found are not significant (Table 17). The longer body length of the female animals may explain the higher number of ventral scales, as may be seen from Figure 9. The relative length of the ventral scales is different in males and females, but only slightly so, the difference between the averages having no statistical significance. However, as the animal grows, the relative length of the ventral scales diminishes throughout life, as is consistent with continuous growth. For males and females these lines are practically parallel to each other, the line for males lying below that for females.

When we consider the difference between the length of the smallest and that of the longest animal as an exponent of the life-span, we may use these figures as the beginning and the end of an ordinate and put the index between the number of ventral shields and the body length in the abscissa. The figures for male and female animals then coincide from a body length (in female animals) of 230 mm. upwards. Up to that length the area where the males are to be found is below that of the females. There may be an indication that this index has a fixed value at each age and for both sexes.

TABLE 17

Calamaria multipunctata (collection Kopstein), body length in mm and number of ventral scales

	N	R	M ± ó$_m$	ó	V	r	Z
	MALES						
Body length ..	18	159–306	222.8±8.7	37	16.2	r= ±0.500	Z=0.55±0.26
N ventr. scales ..	18	134–149	139.3±1.–	4.2	3.–		
Index ..	18	48– 85	64.3±2.6	11.–	17.1		
	FEMALES						
Body length ..	48	164–338	261.4±4.9	33.8	12.9	r= ±0.160	Z=0.16±0.15
N ventr. scales ..	48	150–166	155.9±0.6	4.2	2.7		
Index ..	48	49– 98	62.8±1.3	9.1	14.5		

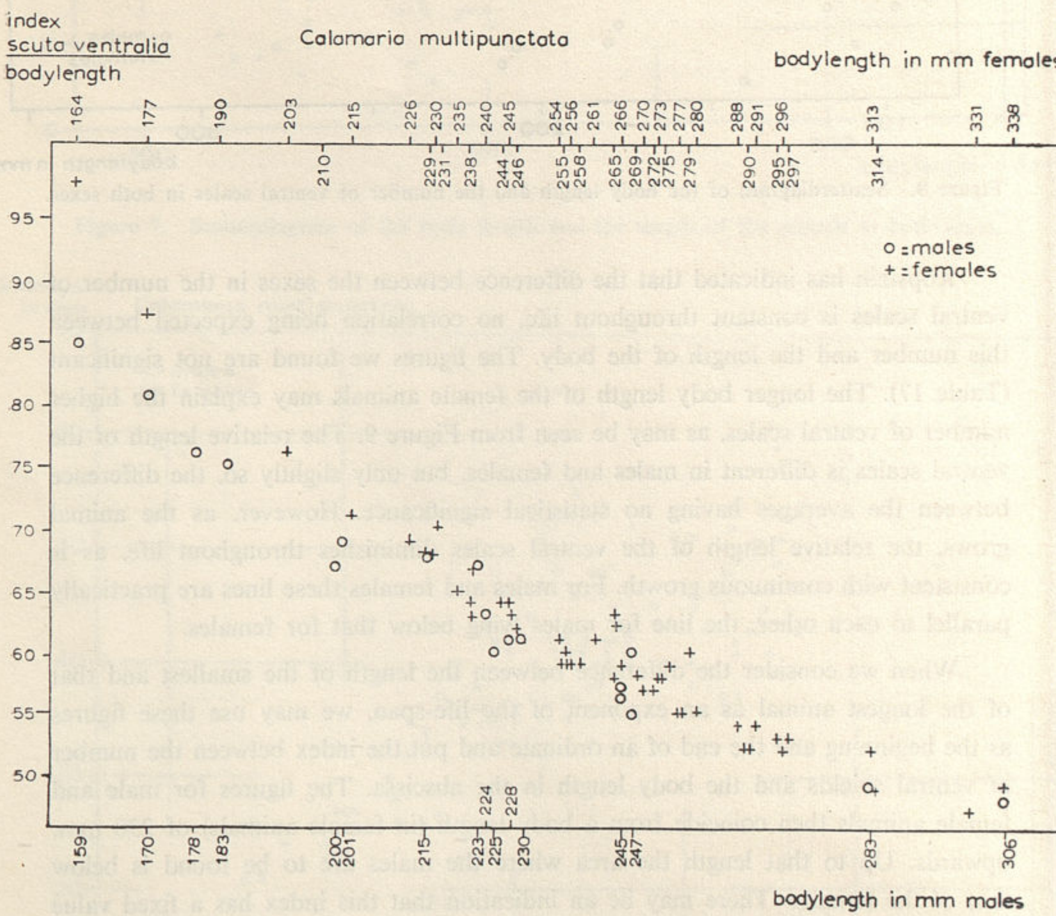

Figure 10. Scatterdiagram of the body length and the index ventral scales: body length in both sexes.

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Acetes (Sergestidae) from the Malay Peninsula

By D. PATHANSALI

Fisheries Research Institute, Glugor, Penang

(*Received, September 1965*)

INTRODUCTION

Although a minor crustacean group represented by a few species, the genus *Acetes* Milne-Edwards supports a subsistence fishery of some considerable importance in the Malay Peninsula (Tham, 1950: 9). It appears in very large swarms in the shallow inshore coastal waters, which is brackish with a salinity of 30 parts per thousand or less, during certain seasons of the year. It is taken by the push-net, beach-seine, small purse-seine and stake-traps. Only a very small proportion of the catch is disposed off as fresh shrimp but the greater part is dried and sold as dried shrimp or processed into a paste known locally as 'Belachan' or pickled whole to give a product known as 'Chinchalok'.

INDO-MALAYSIAN SPECIES OF *ACETES*

Eleven species are recorded for the Indo-Malaysian Region by Kemp (1917), Hansen (1919), Nataraj (1947), Tham (1950, 1954), and Wickstead (1961). These records, however, contain synonymous species which have been dealt with by Burkenroad (1934), and the valid species are now reduced to seven:

Valid species	Synonyms
A. erythraeus Nobili	*A.* sp. Hansen
A. indicus Milne-Edwards	*A. spiniger* Hansen
A. japonicus Kishinouye	*A. dispar* Hansen
A. serrulatus Kroyer	*A. insularis* Kemp
A. serrulatus var. *johni* Nataraj	....
A. sibogae Hansen	*A. erythraeus* (part) Kemp & *A. australis* Colefax
A. vulgaris Hansen	....

Tham (1950, 1954) records and describes the four species, *A. dispar, A. erythraeus, A. serrulatus* and *A. vulgaris* for Singapore waters but Wickstead (1961) states that only the last two and *A. spiniger* occur there. Johnson (1965) records only *A. vulgaris* but later states (personal communication) that *A. spiniger* should also be included. The present record shows five species from that area.

MALAYAN SPECIES OF *ACETES*

Altogether six species are represented in the present collections taken from the waters of the Malay Peninsula and Singapore. Types of a male and female *A. dispar* were loaned to me by the Zoology Museum, University of Copenhagen, through

the courtesy of Dr. T. Wolff; a sample of *A. japonicus* from Japan and a collection of *Acetes* from Singapore through the kindness of Drs. W. Ikematsu and Tham Ah Kow respectively.

Acetes erythraeus Nobili

A. erythraeus Kemp 1917; Menon 1933.

Sample locality: Kuala Trengganu on the East Coast of the Malay Peninsula; a single sample containing a few hundred specimens of almost uniform size, April, 1961. Singapore, included amongst other species of *Acetes*.

Remarks: The Malayan species agree with the descriptions and figures of Kemp (1917) and Menon (1933). *Acetes* sp. Hansen (1919) is obviously this species. As his description is based on only one specimen the points of differences mentioned by Menon to distinguish it from *A. erythraeus* lie within the variations exhibited by this species as observed in the present collection, and indicated by Kemp and Menon.

Acetes indicus Milne-Edwards

A. indicus Kemp 1917.
A. spiniger Hansen 1919.

Sample locality: Pantai Tanah Merah and Banda Hilir, Malacca, October, 1962. Several hundred specimens exclusively of this species; Perak, November, 1964.

Remarks: Both Kemp (1917) and Hansen (1919) considered the description and figures of *A. indicus* by Milne-Edwards inadequate to determine the specific identity of the species described by him.

Kemp on the basis of locality describes and figures his specimen as *A. indicus,* stating that the only identifying character which distinguishes it from *A. japonicus* is the presence of a tooth, on the external margin of the exopod of the uropod, separating the ciliated and non-ciliated parts.

If the descriptions and figures of *A. indicus* by Kemp and *A. spiniger* by Hansen are compared they are seen to refer to the same species, and specimens of the present collection are identified as *A. indicus* following Kemp.

Acetes japonicus Kishinouye

A. japonicus Kishinouye 1905; Kemp 1917.
A. dispar Hansen 1919.

Sample locality: Glugor and Batu Maung, Penang Island, most months of the year. Kuala Tanjong Dawai, Kedah, September, 1963. The collections from both Penang and Kedah contained *A. japonicus* and *A. sibogae,* but while the former was the dominant form in the Penang collections, it was the reverse with the Kedah collections. It is the smallest of the *Acetes* recorded in the Malay Peninsula. Singapore, amongst other species of *Acetes*.

Remarks: I have examined and compared *A. japonicus* from Japan with types of *A. dispar* of Hansen and the Malayan species and find them to be remarkably similar. The Japanese sample contained specimens showing greater variation due to the two types of generations shown by this species in Japanese waters (Ikematsu, 1953). The obvious differences are in size, one generation being larger than the other, and in the relative lengths of the processus ventralis of the petasma of the male, and in the shape of the female genital plate. The last is also observed in the Malayan species.

Acetes serrulatus Kroyer

A. insularis Kemp 1917.

A. serrulatus Hansen 1919.

Sample locality: Singapore waters, amongst other species of *Acetes;* not recorded elsewhere in the Malay Peninsula.

Remarks: Kemp's *A. insularis* is without doubt *A. serrulatus* Kroyer (1859). A comparison of his figures with those of Hansen's based on Kroyer's specimen in the University of Copenhagen show them to be identical.

Acetes sibogae Hansen

A. sibogae Hansen 1919.

A. erythraeus (part) Kemp 1917.

A. australis Colefax 1940.

Sample locality: Port Weld, Perak, August, 1961; Glugor and Batu Maung, Penang, most months of the year; Kuala Tanjong Dawai, Kedah, September, 1963; South of Kuala Perlis, Perlis, September, 1963. Large collections from these areas but those from Port Weld contained only this species while those from Penang, Kedah and Perlis included *A. japonicus*. The specimens taken at Kedah and Perlis were much larger than those taken in the other localities.

Remarks: The specimens in the present collection differ from the description and figures of *A. sibogae* Hansen in that not only the female but also the male possesses a tooth on the coxa (as in the males of this genus). Except for this difference the specimens otherwise agree very well in the more important characters. The presence of a 'tooth' which is not strictly comparable to that in *A. indicus* on the inner margin of the basis is quite conspicuous in both large adult males and females and may be used as a diagnostic character to distinguish it from the other species.

I am of the opinion that *A. australis* Colefax is *A. sibogae* or only a variety of this species. In describing the species Colefax compares it with *A. erythraeus* and *A. indicus* and not with *A. sibogae*. The characters mentioned by Colefax to distinguish *A. australis* from *A. erythraeus* and *A. indicus* agree very closely with those of *A. sibogae*. However, in the antennule, 'the angular projection on the segment following the one which carries the clasping spine', described by him is absent in *A. sibogae*. In describing the petasma Hansen states that there are two falcate spines of equal size on the capitulum, while Colefax records only one falcate spine. I have observed the capitulum to have one or two spines, the distal one may be so small that it is obscured by the larger proximal one. The distal spine is not as large as the proximal one as described by Hansen. I would agree with Burkenroad (1934) that the dimorphic male of *A. erythraeus* described by Kemp (1917) is none other than *A. sibogae*. Kemp states that the males from Penang differed from all other males of *A. erythraeus* from other localities in that the third antennular peduncle is greatly elongated, his 'high form', and that they were of smaller size, 14 mm. Although intensive collections have been made around Penang Island and off the coasts of Kedah and Perlis, *A. erythraeus* has so far not been recorded.

Acetes, vulgaris Hansen

A. vulgaris Hansen 1919.

Sample locality: Singapore, together with other species of *Acetes*.

Remarks: This species has not been recorded elsewhere in the Malay Peninsula; found in brackish water in or near prawn ponds, in mangrove areas.

KEY TO THE MALAYAN SPECIES

An artificial key for the identification of the adult male and female is given below. For detailed descriptions and figures, reference should be made to Kemp (1917), Hansen (1919), Menon (1933) and Colefax (1940).

MALES

A. Procurved spine between 1st pair of pleopods.

a. Trochanter (basis) with tooth on inner free margin .... *A. indicus*

b. Trochanter (basis) without tooth .... *A. erythraeus*

B. No procurved spine between 1st pair of pleopods.

a. External antennular flagellum with two clasping spines.

i. Segment preceeding the one bearing the clasping spines with angular process pointing backwards .... *A. serrulatus*

ii. Segment preceeding the one bearing the clasping spine without any process *A. japonicus*

b. Distal margin of the trochanter (basis) of the third leg ends in a blunt outward projection. (Third segment of antennular peduncle not less than twice the length of the 2nd segment) .... *A. sibogae*

c. Distal margin of the trochanter (basis) of the third leg does not end in a blunt outward projection. (Third segment of antennular peduncle not more than one and three-quarter times the length of the 2nd segment) .... *A. vulgaris*

FEMALES

A. Procurved spine between 1st pair of pleopods.

a. Trochanter (basis) with tooth on inner free margin .... *A. indicus*

b. Trochanter (basis) without tooth .... *A. erythraeus*

B. No procurved spine between 1st pair of pleopods.

a. Apex of telson rounded or truncated.

i. Apex of telson truncated and with a tooth at each corner .... *A. serrulatus* (also juveniles of *A. dispar* but ciliated and non-ciliated parts of outer margin of exopod of uropod not separated by tooth in both juveniles and adults as in *A. serrulatus*).

ii. Apex of telson rounded and third thoracic sternite produced posteriorly as large plate .... *A. japonicus*

b. Apex of telson triangular.

i. Distal margin of trochanter (basis) of third leg ends in a blunt outward projection *A. sibogae*

ii. Not so .... *A. vulgaris*

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I wish to thank Mr. Soong Min Kong, Director, Fisheries Division, Ministry of Agriculture and Co-operatives, Malaysia, for the keen interest and encouragement he has given in this study and for permission to publish this paper.

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BULLETIN OF THE NATIONAL MUSEUM SINGAPORE

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A new species of *Balanus* (Crustacea: Cirripedia) from Singapore

By ARIFFIN SUHAIMI

Zoology Department, University of Singapore

(*Received, September 1963*)

INTRODUCTION

During a study of the ecology of the genus *Balanus* da Costa in Singapore waters, a hitherto undescribed species of the genus was found inhabiting large sponges of the species *Suberites inconstans* (Dendy). The specimens belong to the subgenus *Membranobalanus* Darwin.

DESCRIPTION

Balanus (Membranobalanus) basicupula sp. nov. Figures 1 & 2.

Holotype.—Specimen BM. 1965.7.13.1, Labrador Coast, Singapore, 10.8.1960, collected by A. Suhaimi, deposited in the British Museum (Natural History), London.

Paratypes.—Other specimens of the same series and with the same data, deposited in the British Museum (Natural History), BM. 1965.7.13.2; the National Museum, Singapore, NMS. 1304; and the Department of Zoology, University of Singapore.

Other Material.—Numerous specimens from low water spring tide level at Tanjong Gul on the West coast of Singapore, and Pulau Hantu, south of Singapore.

Diagnosis.—A small barnacle belonging to the sub-genus *Membranobalanus*, distinguished by its flexible, membranous shell and large cup-shaped ventral portion.

Size.—Adult specimens examined averaged 1 cm. along the opercular-basal axis and 0.6 cm. in rostro-carinal diameter.

Shape.—The species is elongated along the opercular-basal axis, and laterally somewhat depressed. The basal region is prominently cup-shaped and extends for about twice the height of the shell beyond the basal margin. It is supported by a downward extension of the rostal compartment. Above the basal margin, the shell is conical with a large, entire orifice.

Shell.—The shell is thin, smooth and membranous and there is little internal deposition of calcareous material. The parietes are not porose. The rostral compartment extends far beyond the basal margin of the other compartments. This basal extension tapers downwards, terminating in a point.

Opercular valves.—These are relatively thick and well calcified and possess distinct growth ridges. They are not well sculptured internally. They are attached to the shell very close to the basal margin and are relatively large in comparison with the compartments.

Scutum (fig. 1*b*).—There is no adductor ridge. The articular ridge is moderately developed and has an angular margin and oblique lower edge. The pit for the depressor muscle can be clearly distinguished.

Tergum (fig. 1*c*).—This is usually beaked. The carinal margin is slightly convex and rounded, whilst the scutal margin is concave. The spur is extremely short and it is situated close to the basi-scutal angle. The lower edge of the spur is rounded. The articular ridge is moderately developed.

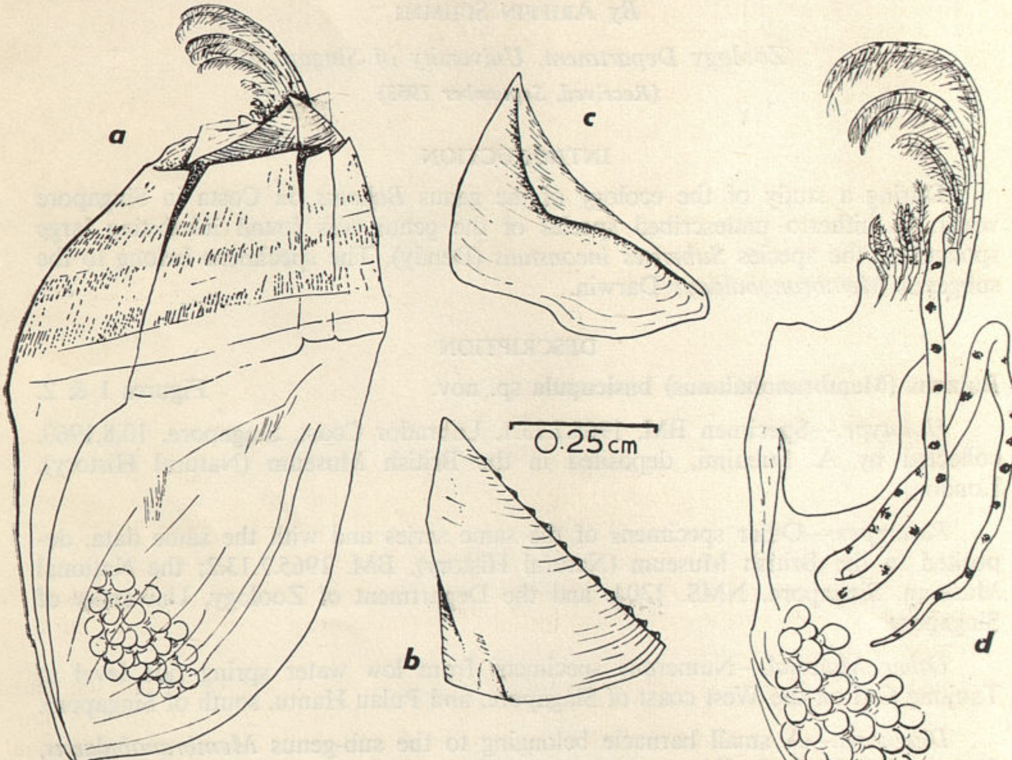

Figure 1. ***Balanus* (*Membranobalanus*) *basicupula*** **sp. nov.; *a* whole specimen, *b* scutum (exterior view), *c* tergum (interior view), *d* dissected specimen to show the elongated penis.**

Mouthparts.—The Labrum (fig. 2*a*) is sub-rhombiform rather than triangular and has rounded lateral edges. The labral notch is not deep. It has a wide entrance on each side of which there are three teeth. The Palpi (fig. 2*b*) are boat shaped with the superior margin somewhat hollowed out. The Mandible (fig. 2*c*) has three large, prominent teeth, placed far apart, and three rudimentary teeth placed close together near to the inferior angle. The last of these rudimentary teeth is pointed, so that the inferior angle appears to be bifurcated. There is a further rudimentary tooth between the second and third prominent teeth. The 1st Maxilla (fig. 2*d*) has a straight free border. No small notch can be seen under the upper pair of spines.

The number of spines between the upper and lower pairs of larger spines varies between four and five. The 2nd Maxilla (fig. 2*e*) is club-shaped and covered with hairs. A group of numerous hairs extends from part of the outer border over to the whole of the inner border. These hairs are directed inwards and downwards.

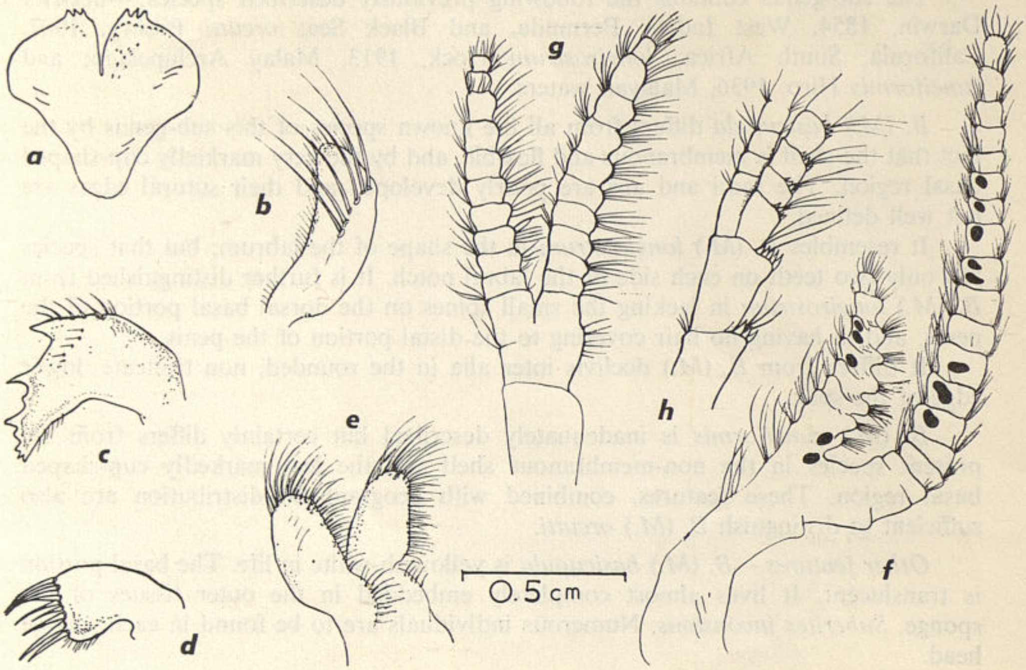

Figure 2. ***Balanus*** **(*Membranobalanus*) *basicupula*** **sp. nov., mouth parts and cirri of thoracic appendages; *a* labrum, *b* palpi, *c* mandible, *d* first maxilla, *e* a pair of second maxilla, *f* first cirri, *g* third cirri, *h* part of fourth cirri showing comb-like spines.**

Thoracic appendages.—In this section the number of segments given refers to fully adult individuals. In certain instances juveniles may have a smaller number of segments.

The first cirri have two very unequal rami of 8 and 19 segments. The segments of the shorter ramus are protuberant on the anterior face. There are tufts of hairs on the distal edges of these protuberances. The second cirri have equal or sub-equal rami with either 10 segments in each ramus or 8 in the shorter and 10 in the longer. The segments are rounded and covered with hairs. The 3rd cirri resemble the second pair but have longer rami each containing 13 segments. The fourth cirri (fig. 2*f*) are about twice as long as the third pair and have sub-equal rami. The shorter ramus has 25 segments, whilst the longer has 30 segments. The shorter ramus, which is the endopodite, bears a prominent comb-like row of spines at the anterior distal border of each segment. The segments of the exopodite lack these spines. The fifth and sixth cirri resemble the fourth but are longer and with more numerous segments and do not possess spines of any kind on either ramus.

Male genitalia (fig. 1*d*).—The penis is probosciform and extremely long, being about three times the length of the last pair of cirri. It is folded three times beneath the body. There are no spines on the dorsal basal region and the distal portion is not covered with hairs or bristles.

Affinities.—This species falls into the subgenus *Membranobalanus* Darwin, since it possesses the following characters:—(1) the base is membranous and cup-shaped; (2) the rostral compartment extends beyond the basal margin; (3) the parietes are not porose; (4) the radii are poorly developed; (5) the adductor ridge of the scutum is scarcely developed; and (6) the spur of the tergum is short.

The sub-genus contains the following previously described species:—*declivis* Darwin, 1854, West Indies, Bermuda, and Black Sea; *orcutti* Pilsbry, 1907, California, South Africa; *longirostrum* Hock, 1913, Malay Archipelago; and *cuneiformis* Hiro, 1936, Malayan waters.

B. (*M.*) *basicupula* differs from all the known species of this sub-genus by the fact that the shell is membranous and flexible, and by the very markedly cup-shaped basal region. The radii and alæ are poorly developed and their sutural edges are not well defined.

It resembles *B.* (*M.*) *longirostrum* in the shape of the labrum; but that species has only two teeth on each side of the labral notch. It is further distinguished from *B.* (*M.*) *longirostrum* in lacking the small spines on the dorsal basal portion of the penis, and in having no hair covering to the distal portion of the penis.

It differs from *B.* (*M.*) declivis inter alia in the rounded, non truncate, lower edge of the spur.

B. (*M.*) *cuneiformis* is inadequately described but certainly differs from the present species in the non-membranous shell and the less markedly cup-shaped basal region. These features, combined with geographical distribution are also sufficient to distinguish *B.* (*M.*) *orcutti*.

Other features.—*B.* (*M.*) *basicupula* is yellowish-white in life. The basal portion is translucent. It lives almost completely embedded in the outer tissues of the sponge, *Suberites inconstans*. Numerous individuals are to be found in each sponge head.

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I wish to thank Dr. C. H. Fernando for helpful criticisms and suggestions; Dr. D. S. Johnson for assistance in the preparation of this paper; and Mr. E. R. Alfred of the National Museum, Singapore, for access to the collections and the library in the museum.

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BULLETIN OF THE NATIONAL MUSEUM SINGAPORE

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Nesting Beach Preferences of Malayan Sea Turtles[1]

By J. R. HENDRICKSON

Centre for Cultural and Technical Interchange between East and West, University of Hawaii, Honolulu,

and E. BALASINGAM

Zoology Department, University of Malaya, Kuala Lumpur.

(*Received, December 1965*)

At the 9th Pacific Science Congress held in Bangkok in 1957, Hendrickson and Alfred (1958 & 1961) reported on nesting populations of Sea Turtles on the east coast of Malaya and gave an indication of their nesting concentrations and species distribution. They showed that, in all, four species of marine turtles (*Chelonia mydas* (Linn.), *Dermochelys coriacea* (Linn.), *Lepidochelys olivacea* (Esch.), and *Chelonia imbricata* (Linn.) nest along the east coast of Malaya, and called attention to the extraordinary lack of homogeneity in distribution of breeding beaches of these species. Investigations have continued since then and it is observed that these differences in nesting concentrations and species distribution appear to be largely due to the selectivity shown by different species of turtles in chosing their nesting beaches. The present writers have paid particular attention to the possible factors underlying selectivity of beach types by different species of turtles.

In 1958 the turtle beaches from the Thailand border to South Trengganu were revisited during the nesting season. In all, 30 licensed areas were surveyed[2]. These areas comprise over 90 per cent of the 165 miles of coast line concerned. In each area the turtle egg licencee or his egg collectors were interviewed and detailed studies were made of the nesting beaches. During the interview, questionnaires were filled in. These were designed to gather information on nesting concentrations, nesting seasons, and species of turtle utilising each licensed area, as well as to obtain information on the economics of the turtle-egg collection industry to be used in another study. The design of the questionnaire included provision for cross-checks on the accuracy of the information obtained. In a number of areas (particularly those where the information obtained by interview was suspected to be inaccurate) the writers spent a night or two on the beaches concerned in order to gain first-hand experience of nesting conditions.

Studies conducted at the time of the visits to the nesting beaches included plotting the profiles of selected beach transects and collecting sand samples from various levels of the beach, (high beach platform, littoral slope, etc.) along these transects. Such observations were made at 50 different points.

1. Presented at the 10th Pacific Science Congress, Honolulu, Hawaii, 1961.
2. The taking of sea turtle eggs in Malaya is controlled by law. Exclusive rights to collect turtle eggs on specified areas of beach are granted by Government licences, tenders being accepted annually and the licences usually going to the highest bidders.

Data obtained through questionnaires indicates that of the four species listed above, the Hawksbill (*Chelonia imbricata*) occurs infrequently in Malayan waters and its contribution to the total egg production is negligible. The Pacific Ridley (*Lepidochelys olivacea*) nests in somewhat larger numbers (approximately one to every ten *Chelonia mydas*), but shows no tendency to congregate in particular areas for nesting; it has not been possible to define any particular area on the east coast of Malaya where this species characteristically nests in predictable numbers. The Green Turtle (*Chelonia mydas*) and the Giant Leathery Turtle (*Dermochelys coriacea*), however, nest in much larger numbers and the areas predominantly used by each species are well defined. An area in Central Trengganu is used almost exclusively by *Dermochelys coriacea* and the beaches north and south of this are used predominantly by *Chelonia mydas* (as well, all the suitable island beaches are used by *Chelonia mydas*).

The nest densities (i.e., the number of turtle nests per mile per annum) along the *Dermochelys* beaches are generally much higher than those of the *Chelonia beaches* (fig. 1). This is particularly true of Rantau Dalam and adjoining licenced areas in Central Trengganu, where the maximum nest density reaches 2,500 nests per mile per annum. In this area there is hardly any admixture of other species of turtles. The nest densities along the *Chelonia* beaches on the other hand are comparatively low, but this species also shows a tendency to congregate for nesting on relatively small areas of the beach. The contribution of *Dermochelys coriacea* to egg production on these *Chelonia* beaches is negligible.

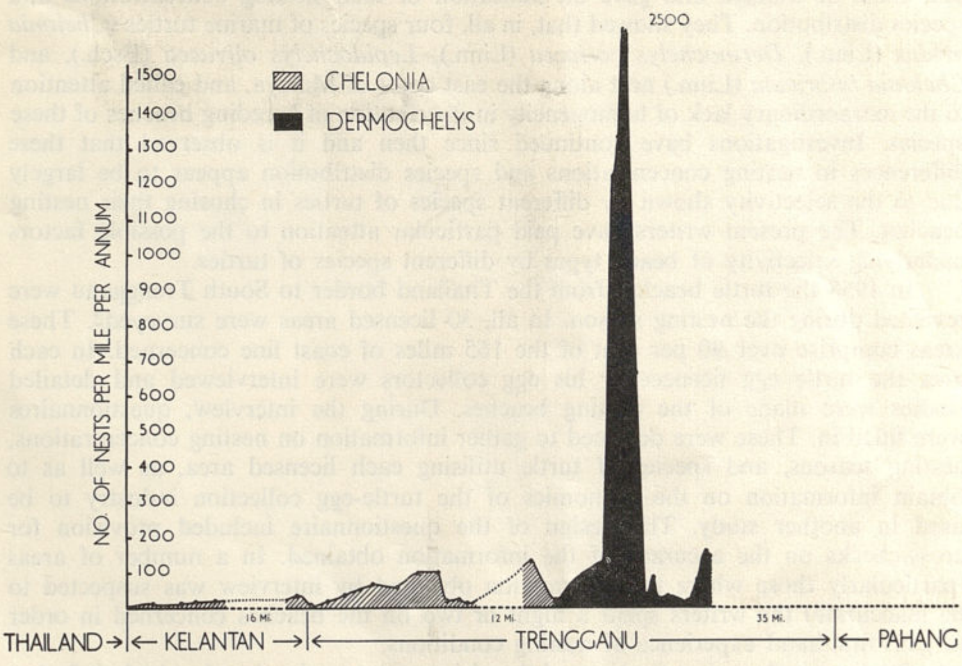

Figure 1. Number of nests per mile per annum.

An exhaustive preliminary analysis (for particle size, water retentivity, contained air volume, carbonate content, and organic content) of sixteen sand samples collected from two contrasting beach types, "known *Chelonia* beach" (Pantai Chinta Brahi and Pantai Hiboran in Kelantan) and "known *Dermochelys* beach" (Rantau Dalam in Trengganu), showed contrasting results particularly with reference

to particle size (figs. 2 & 3). On the basis of these findings, the sand samples from the remaining 48 sites were tested for particle size. This analysis shows that there is a predominance of "fine" sand, i.e. sand passing through a 44 mesh (0.0139 inches or 353 microns) sieve, in *Chelonia* beaches and of "coarse" sand, i.e. sand held in a 30 mesh (0.0197 inches or 500 microns) sieve, in *Dermochelys* beaches.

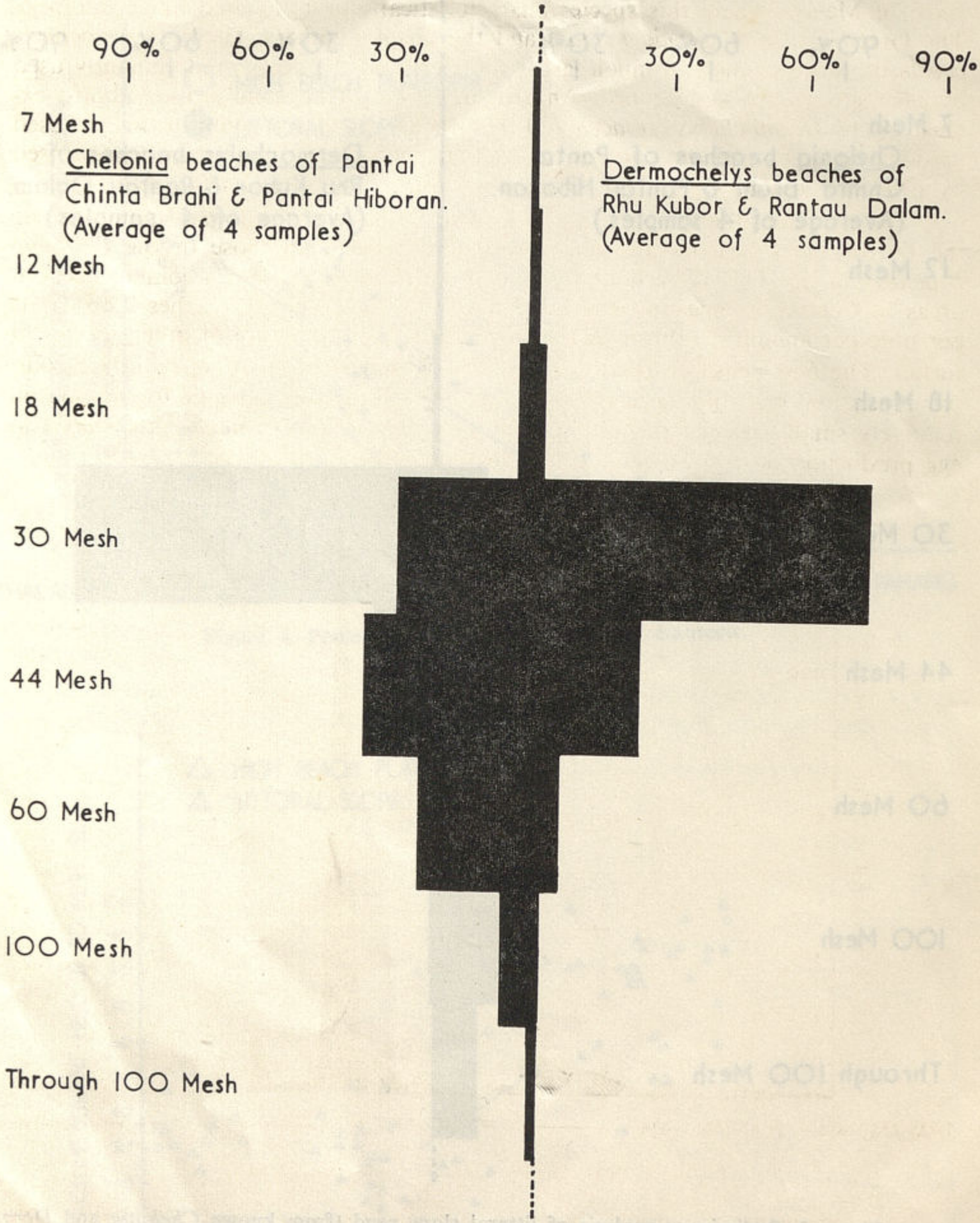

Figure 2. Preliminary analysis of high beach platform sand (from known *Chelonia* and *Dermochelys* beaches) for particle size by volume.

A rough gradient exists from about 90 per cent by volume of "fine" sand and less than 10 per cent by volume of "coarse" sand in the north (*Chelonia* area) to about 10 to 20 per cent "fine" sand and 80 per cent or more "coarse" sand in the Central

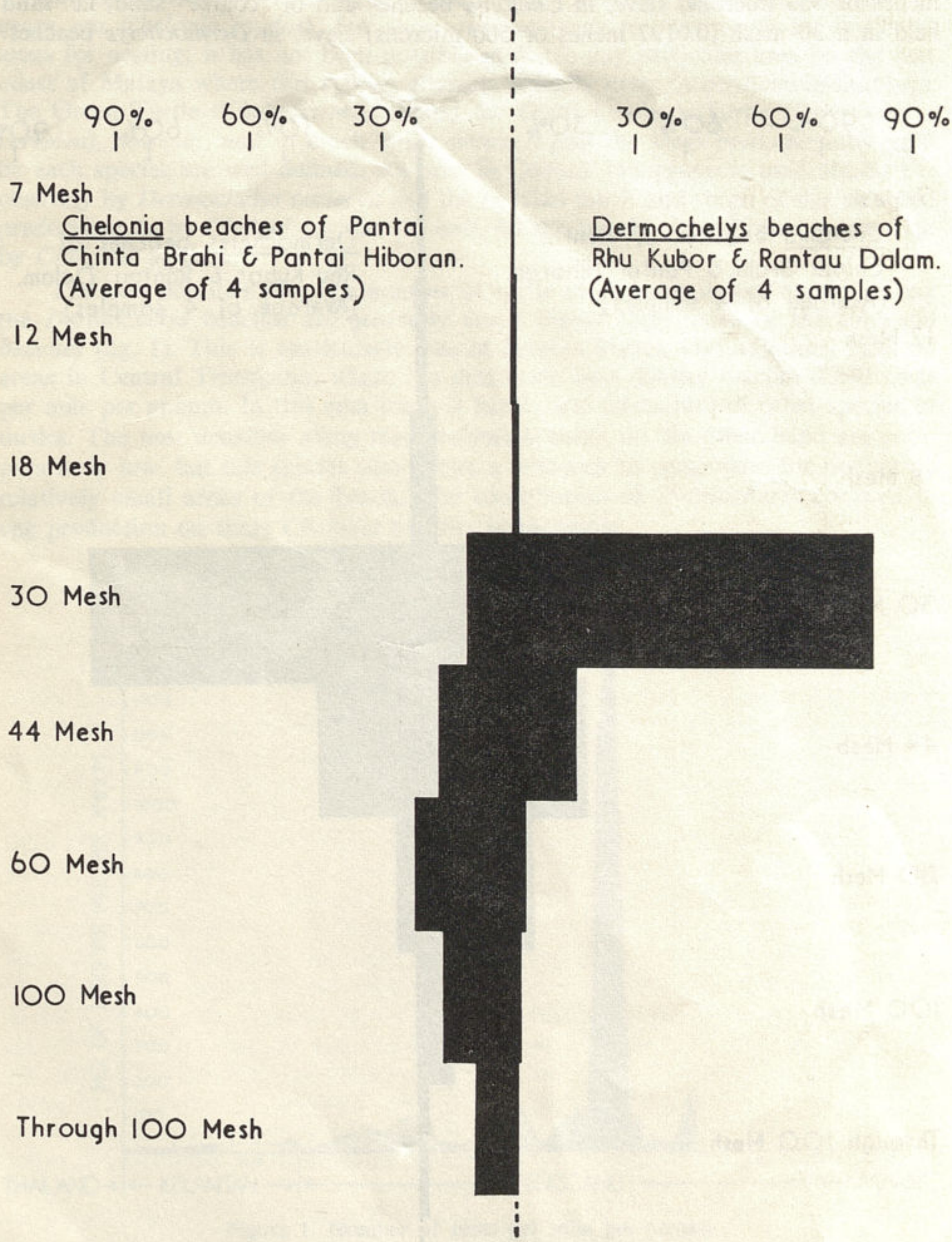

Figure 3. Preliminary analysis of littoral slope sand (from known *Chelonia* and *Dermochelys* beaches) for particle size by volume.

Trengganu area used by *Dermochelys* (figs. 4, 5 & 6). This difference in particle size is most marked in the case of the littoral slope sand which turtles first contact upon emergence from the sea to nest. It produces a marked difference in texture which may well be detectable by arriving turtles. It therefore seems possible that the "feel" of the sand may influence the female turtles' selection of a nesting beach.

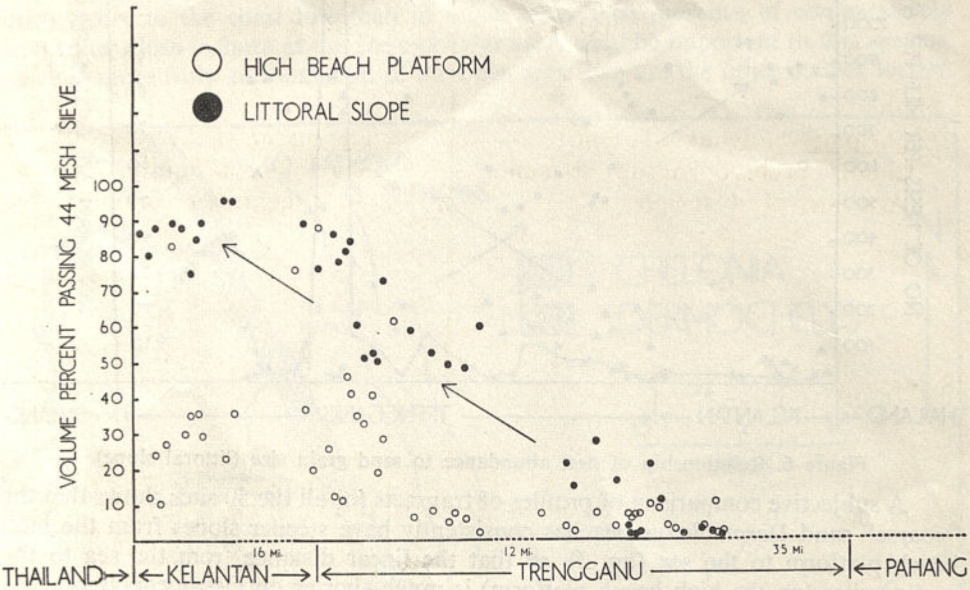

Figure 4. Percentage "fine" sand at beach transects.

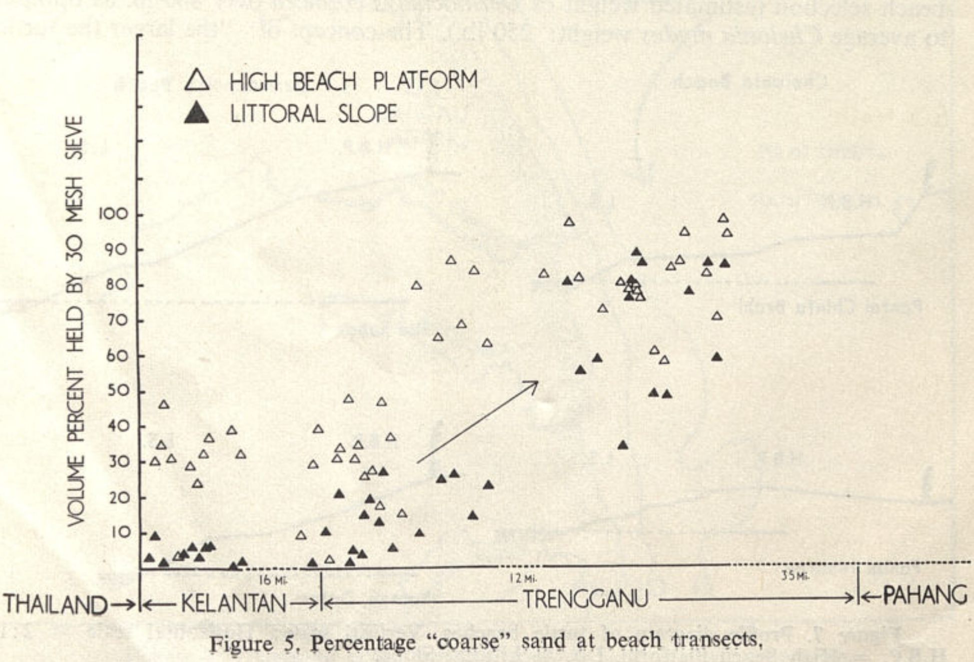

Figure 5. Percentage "coarse" sand at beach transects.

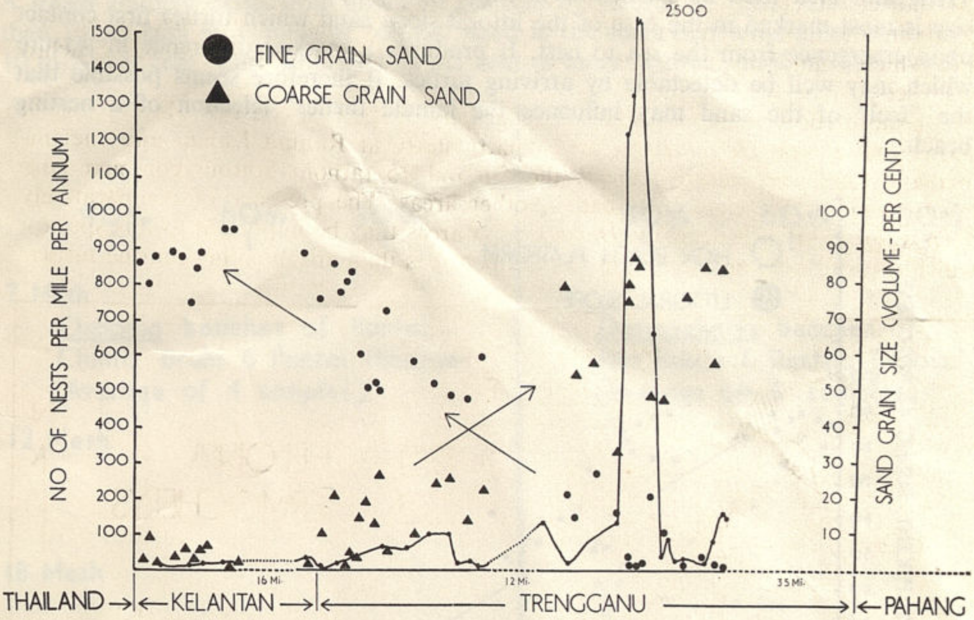

Figure 6. Relationship of nest abundance to sand grain size (littoral slope).

A subjective comparison of profiles of transects for all the 50 sites shows that the "coarse" sand *Dermochelys* beaches consistently have steeper slopes from the high beach platform to the sea (fig. 7), so that the linear distance from the sea to the nesting sites (on the high beach platform) is much shorter on *Dermochelys* beaches than on *Chelonia* beaches. The shorter crawl overland may be important to the much larger and heavier *Dermochelys* and could, perhaps, account in part for the beach selection (estimated weight of *Dermochelys coriacea* over 800 lb. as opposed to average *Chelonia mydas* weight: 250 lb.). The concept of: "the larger the turtle,

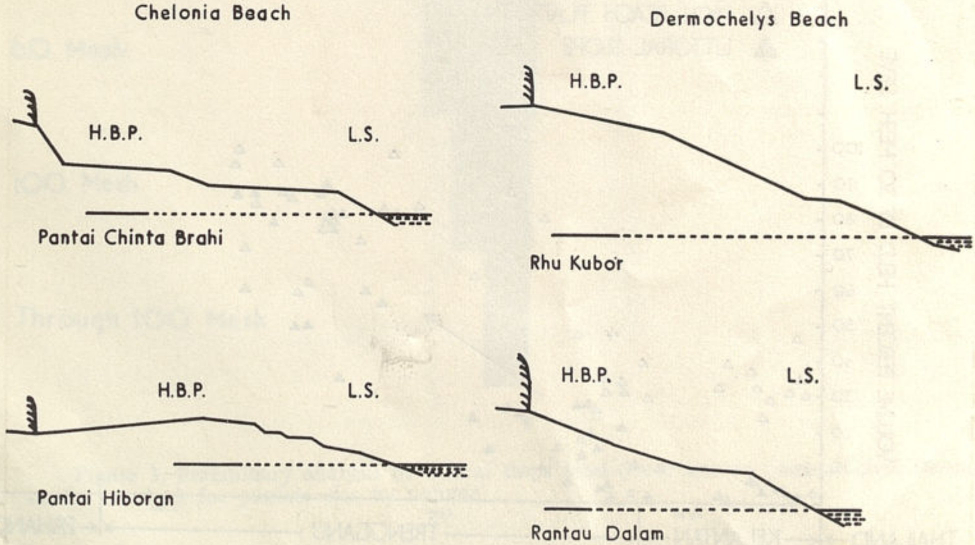

Figure 7. Profile diagram of turtle beaches. Vertical scale: Horizontal scale = 2:1. H.B.P. = High Beach Platform. L.S. = Littoral Slope.

the shorter the chosen crawl" is not contradicted by *Lepidochelys olivacea* (weight of about 100 lb.), which is smaller and more active on land than *Chelonia mydas*, and which commonly nests well above high tide line on very broad flat beaches not used by the heavier turtles.

Examination of the sea bottom topography of the east coast of Malaya (fig. 8) shows that in the *Dermochelys* areas, particularly at Rantau Dalam and the immediately adjacent licenced areas, the 10 and 15 fathom bottom contours pass much closer to the coast line than in other areas. The presence of comparatively deep water close inshore at the *Dermochelys* areas may be important to this species, which is more truly an inhabitant of the open seas than are the other marine turtles.

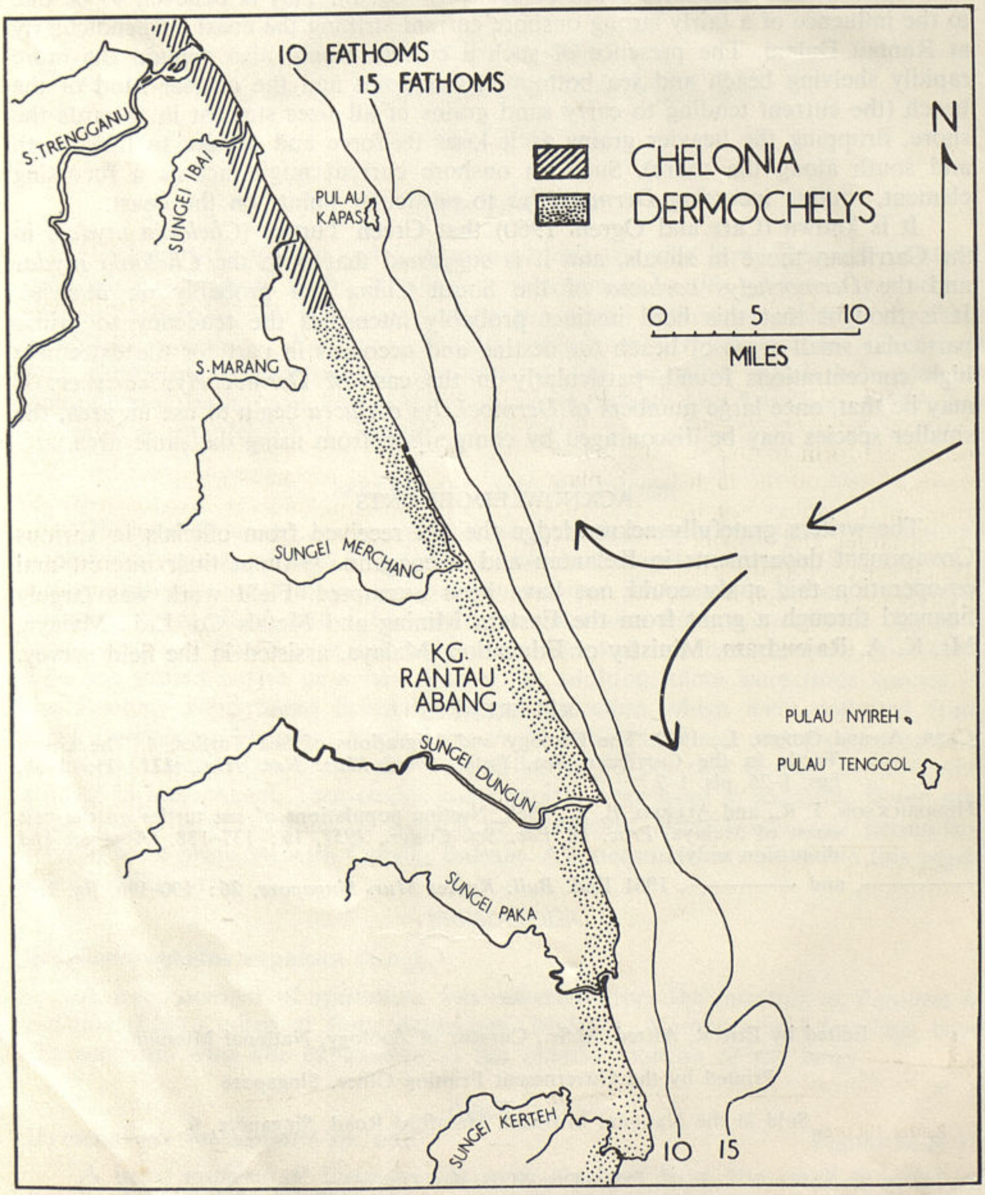

Figure 8. Trengganu coast, subtidal contours and postulated currents.

Further, the rapidly shelving bottom at the water line must facilitate the approach of the larger, much heavier turtles to the beach. In the *Chelonia* nesting areas on the mainland there are commonly wide zones of shallow water, often exposed at low tides, and the incoming turtles must sometimes make their way over these without sufficient depth of water to allow floatation. On the island beaches used by *Chelonia* there are usually fringing coral reefs and it is common to find turtles clambering over exposed reefs during periods of low tide. None of these conditions prevail on the *Dermochelys* beaches.

Aerial photographs of the Trengganu coast show that to the north and south of Rantau Dalam (the site of peak nesting concentration for *Dermochelys*), the river spits extend north and south respectively (fig. 8). This is believed to be due to the influence of a fairly strong onshore current striking the coast perpendicularly at Rantau Dalam. The presence of such a current would also explain the more rapidly shelving beach and sea bottom at this point and the coarser sand of the beach (the current tending to carry sand grains of all sizes straight in towards the shore, dropping the heavier grains as it loses its force and divides to flow north and south along the shore). Such an onshore current might act as a focussing element, routing incoming *Dermochelys* to particular points on the coast.

It is known (Carr and Ogren, 1960) that Green Turtles (*Chelonia mydas*) in the Carribean move in shoals, and it is suggested that both the *Chelonia mydas* and the *Dermochelys coriacea* of the South China Sea probably do likewise. It is thought that this herd instinct probably intensifies the tendency to utilise particular small areas of beach for nesting and accounts in part for the extremely high concentrations found, particularly in the case of *Dermochelys coriacea*. It may be that, once large numbers of *Dermochelys coriacea* begin to use an area, the smaller species may be discouraged by competition from using the same area.

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Some helminths from Malayan wild birds with descriptions of two new species

By O. P. LEE

Zoology Department, University of Singapore

(*Received, July 1963*)

INTRODUCTION

Hitherto, little is known of helminths of Malayan wild birds although intestinal infestation is believed to be of common occurrence. In this preliminary study of helminths of wild birds in Malaya and Singapore the author came across only three published records: — *Raillietina insignis* (Steudener), *Hajelia inermis* (Gœdelest) and *Raillietina paucitesticulata* (Fuhrmann). On the other hand, helminths of domesticated birds have been studied more intensively and Lancaster (1957) has compiled a comprehensive checklist.

MATERIALS AND METHODS

During the present study the following birds were examined: — 6 *Aplonis panayensis strigatus* (Horsf.), 2 *Oriolus chinensis maculatus* Vieill., 2 *Pycnonotus goiaver personatus* (Hume), 2 *Passer montanus malaccensis* Dubois, 1 *Rallus striatus gularis* Horsf. and 1 *Caprimulgus macrourus bimaculatus* Peale. In these hosts only one filarid, one spiruroid nematode and one cestode were recovered. The last turned out to be a new species. In addition, there were three species in the Zoology Department helminthological collection which were collected from Batu Berendam, Malacca, from *Pandion h. halietus* (Linn) and *Dendrocygna j. javanica* (Horsf.). The nematodes were killed in 70 per cent alcohol at 60°C and studied in lactophenol. Trematodes and cestodes were fixed in alcoholic Bouin and stained in a weak solution of Erhlich or Delafields' Hæmatoxlin, and permanent mounts were prepared with Canada Balsam. All measurements quoted in this paper are in millimetres.

TREMATODA

Scaphanocephalus expansus (Crepl.)

A large number of specimens was collected from the intestine of *Pandion h. halietus* (Linn.) taken at Batu Berendam, Malacca. Members of this genus have characteristic wing-like expansions in the anterior portion of the body.

CESTODA

Hymenolepis malaccensis sp. nov. Figure 1*a* & 1*b*

A large number of these worms were obtained from the small intestine of *Dendrocygna j. javanica* (Horsf.), at Batu Berendam, Malacca.

The type is 1.36–1.60 long. The immature segments containing only the testes are 0.494–0.507 x 0.130–0.169, the mature segments containing both testes and ovaries measure 0.52–0.767 x 0.156–0.234. The segments containing well developed ovaries measure 0.793–0.806 x 0.169–0.260. The ripe segments with uteri packed with eggs are smaller than the mature segments and measure 0.403–0.728 x 0.299–0.338. The scolex sharply marked off from the strobila, has a maximum width of 0.148–0.217 and a length of 0.269–0.357 from the posterior edge of the suckers. The rostellum is retractile measuring 0.096–0.126 in length and bears a single row of ten sickle-shaped rostellar hooks. The hooks are 0.050–0.053 long with a distal curved narrow blade measuring 0.018–0.022 long in a straight axis. The rostellar sac extends beyond the anterior borders of the suckers and is about 0.085 when the rostellum is fully extended. The suckers measure 0.083–0.096 in width and 0.112–0.124 in length. The proglottides are broader than long with the posterior lateral margin projecting prominently (craspedote). The neck is 0.062–0.093 long and has a minimum width of 0.084–0.140.

The testes vary from round to slightly oval, three in number, all arranged in a transverse row. The longer axis measures 0.118–0.143 and the shorter being 0.078–0.093. They lie behind the ovary. The voluminous subspherical seminal vesicle lies about mid-way along the width of the proglottid just anterior to the ovary and measures 0.0713–0.1395 x 0.0465–0.062 in length and breadth respectively. The genital pore is unilaterally situated immediately behind the projecting posterior edge of the preceding segment. The elongate spindle-shaped cirrus pouch 0.22–0.27 x 0.086–0.089 lies obliquely to the longitudinal axis of the strobila with its inner end near the anterior end of the proglottid. The indented ovary measures 0.48–0.51 x 0.09–0.12. The compact vitelline gland is small, 0.085–0.099 x 0.055–0.062, and is found posterior to the ovary. The ovoid seminal receptacle is exceedingly long measuring 0.263–0.426 x 0.0217–0.0806. It lies on the pore side of the median line. It becomes elongated in the last few gravid segments. In the mature segments the uteri are narrow and transversely elongated. The gravid uterus occupies almost the entire proglottid. The eggs are oval and measure 0.030–0.036 x 0.020–0.024.

Beverly-Burton (1959) maintained that species of the genus *Hymenolepis* Weinland, from the Anseriformes have been proposed on variable characters, e.g., the size of the cirrus and cirrus sac, and size and arrangement of the testes. They considered that the shape, size and number of rostellar hooks are most dependable diagnostic characters of the genus. Hitherto little variability of the hooks of hymenolepids has been found.

Of the species recorded from Anseriformes only two have been known with ten rostellar hooks, *Hymenolepis tenerrima* (von Listow) and *Hymenolepis mandabbi* Beverly-Burton. In the former the hooks measure 0.110 and in the latter they measure 0.095 in length. In the present species the hooks measure 0.050–0.053 and the shape also differs from those mentioned above. The blades of the hooks are curved to almost sickle-shaped and the distal end of the blades are very sharply pointed.

Holotype:—Deposited in the British Museum (Natural History), London.

Paratypes:—Deposited in the Zoology Department, University of Singapore.

Host: —*Dendrocygna j. javanica* (Horsf.)

Location:—Intestine.

Locality:—Batu Berendam, Malacca, Malaya.

Date collected:—28-12-1960.

Raillietina (Paroneilla) singapurensis sp. nov. Figure 1*c*-1*e*

Upon dissection of an *Oriolus chinensis maculatus* Vieill caught in Singapore, the duodenal region showed symptoms of an ulcer externally. When the affected part was opened, two cestodes were found with their scolices deeply embedded in the mucosa. One worm was measured.

Length 24.0. Maximum width 2.0, measured at the gravid segment. Scolex cone-shaped, 0.44 long by 0.49. Rostellum present as a hump measuring 0.082 at the highest point and 0.26 across the base. The rostellum bears two circles of hooks arranged in an alternating fashion with the upper slightly smaller than the lower row. The blade and the handle are formed in a triradiate manner in the shape of the letter T. The distal part of the blade is acutely bent towards the vertical axis. The maximum length of the blade measures 0.015 and 0.019, upper and lower respectively. The handle measures 0.012 and 0.014 for the same. A total of 88 hooks were counted. The circular suckers with a diameter of 0.0978–0.1304 have a belt of peripheral tiny spines 0.008 wide. The neck is 1.353 long by 0.163 wide. Genital pores are unilateral, dextral, located 0.0255–0.0510 from the posterior edge of the preceding segment.

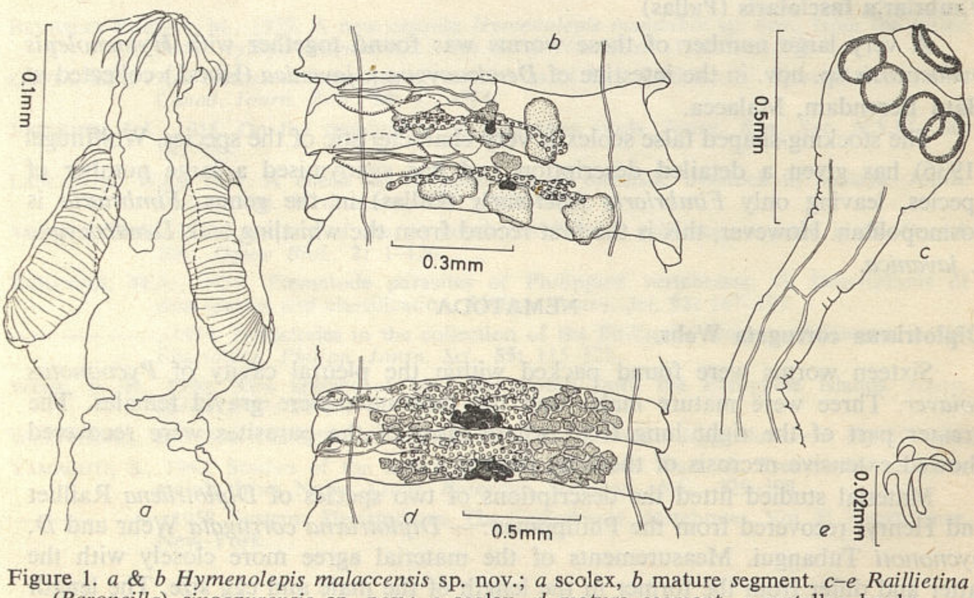

Figure 1. *a* & *b* *Hymenolepis malaccensis* sp. nov.; *a* scolex, *b* mature segment. *c–e* *Raillietina* (*Paroneilla*) *singapurensis* sp. nov.; *c* scolex, *d* mature segment, *e* rostellar hooks.

There are 117 segments in all. The immature segments containing only the testes measure 0.554–1.043 x 0.114–0.815. Segments containing both testes and ovary measure 1.076–1.630 x 0.114–0.130. Segments containing uteri measure 1.875–1.666 x 0.305–0.207. Like most cestodes the proglottides are broader than long. Testes 5–7 poral and 18–20 aporal, measuring 0.017–0.026 x 0.017–0.017. Cirrus sac pear-shaped, measuring 0.043–0.051 x 0.017–0.026. The cirrus is coiled and unarmed. The vas deferens with numerous coils runs in a transverse manner almost reaching the median line of the segment. The seminal vesicle measures 0.0020–0.026 x 0.017–0.017. The ovary is fan-shaped and deeply lobed extending

0.042–0.051 transversely and 0.017–0.019 longitudinally. The vagina lies immediately posterior to the cirrus sac, both opening into a common genital pore. The distal part of the vagina dilates to form the seminal receptacle 0.038–0.051 x 0.017 –0.022. The ovoid vitellarium is slightly lobed and is located posterior to the ovary. It measures 0.011–0.026 x 0.008–0.012. Egg capsules measure 0.0187–0.0289 x 0.0112–0.0204, and contain a single egg measuring 0.0102–0.0119 x 0.0068–0.0085.

Yamaguti (1958) had listed thirty-nine species of the subgenus *Paroniella* Fuhrmann. Of these, two species have been recorded from the orioles:— *Raillietina compacta* (Cler.) and *Raillietina* (*Paroniella*) *culiauana* Tubangui and Masilungan. The present species differs from the related species described in the number of hooks and fewer number of testes.

Holotype:—British Museum (Natural History), London.

Host:—*Oriolus chinensis maculatus* Vieill.

Location:—Duodenum.

Locality:—Singapore.

Date collected:—4-10-1961.

Fimbriaria fasciolaris (Pallas)

A very large number of these worms was found together with *Hymenolepis malaccensis* sp. nov. in the intestine of *Dendrocygna j. javanica* (Horsf.) collected at Batu Berendam, Malacca.

The stocking-shaped false scolex is very characteristic of the species. Wolffhugel (1936) has given a detailed description and has synoymised a large number of species, leaving only *Fimbriaria fasciolaris* (Pallas) in the genus. *Fimbriaria* is cosmopolitan. However, this is the first record from the whistling teal, *Dendrocygna j. javanica*.

NEMATODA

Diplotriæna corrugata Wehr.

Sixteen worms were found packed within the pleural cavity of *Pycnonotus goiaver*. Three were mature males and the remainder were gravid females. The greater part of the right lung from where most of the parasites were recovered showed extensive necrosis of the lung tissues.

Material studied fitted the descriptions of two species of *Diplotriæna* Railliet and Henry, recovered from the Philippines:— *Diplotriæna corrugata* Wehr and *D. pycnonoti* Tubangui. Measurements of the material agree more closely with the latter and differ from the former in the length of the male and egg size. The length of the male of *D. corrugata* is shorter, being 10–15 long. However, the size of eggs is slightly larger, being 0.054–0.050. It is notable that *D. corrugata* was found in the body cavity of *Ptiocichla basilonica* and *D. pycnonoti* from the same host as the present material.

Tubangui (1934) stated that morphologically his specimens fitted Wehr's (1930) description of *D. corrugata* except in the number of caudal papillæ. *D. pycnonoti* possesses six papillæ and *D. corrugata* has seven to eight. The author feels that too much emphasis was attached to small papillæ at the tip of the tail and the concept of the species ought to be broadened in this connection. Over clearing can totally eliminate the small papillæ from view. *D. pycnonoti* is most probably *D. corrugata*.

Acuaria (Dispharynx) emberizæ (Yamaguti); Railliet, Henry & Sisoff

Two mature males and four gravid females were recovered from the duodenum of *Pycnonotus goiaver personatus* (Hume). The heads of the worms were deeply buried in the mucosa. Both males and two females were studied and measured.

Five species of the subgenus *Dispharynx* Railliet, Henry and Sisoff have already been synonymised. *Dispharynx nasuta* (*D. spiralis*) Baylis, *D. stonæ* Harwood, *D. emberizæ* Yamaguti and *D. nasuta* Baylis were synonymised by Medsen (1952) without offering any reason. Gupta (1960) agreed that these forms are conspecific. He also considered that *D. stonæ* Sanwal and *D. nasuta* were the same species.

The present specimen agrees very closely with *D. emberizæ*, especially in the sizes of the eggs. However, it should be pointed out that the present specimen has nine pairs of pedunculate caudal papillæ whereas *D. emberizæ* possesses ten pairs of which two pairs are small and sessile and are located at the tip of the tail.

Gupta (1960) stressed that recent specialists of this group considered that the small sessile caudal papillæ at the tip of the tail are of little diagnostic importance. In addition, the concept of the species has to be broadened as regards the extents of the cordons and the position of the vulva. These characters are considered variations within the species. *Dispharynx* has a wide host range and a wide geographic distribution.

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BULLETIN OF THE NATIONAL MUSEUM SINGAPORE

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A taxonomic study of the Malayan Corixidæ (Hemiptera-Heteroptera) with the description of *Micronecta malayana* sp. nov[1].

By C. Y. LEONG.

Zoology Department, University of Singapore.

(*Received, July 1963*)

INTRODUCTION

The Corixidæ are widespread in Malaya. They are often very abundant in standing water e.g., ponds, pools and the edges of lakes. No taxonomic work has been done so far on Malayan material but a number of species have been recorded by Dover (1928) and Fernando (1961*a*, 1963*a* & 1963*b*). Material from the surrounding countries has been studied to a greater extent however by Lundblad (1933) for Indonesia, and Hutchinson (1940) and Chen (1960) for India and the adjacent areas. Wroblewski (1960) described a number of Asiatic species and Fernando (1964) has dealt with the Ceylonese species. These taxonomic works have dealt with Malayan species and in the present work the Malayan species are described from Malayan material. Nine species namely *Micronecta issa* (Dist.), *M. thyesta* Dist. *M. punctata* Fieb., *M. scutellaris* (Stal.), *M. quadristrigata* Breddin, *M. albifrons* (Motsch.), *Micronecta malayana* sp. nov., *Agraptocorixa hyalinipennis* (F.) and *Tropocorixa connexa* (Lundb.) are described. Keys are given for the separation of Malayan genera and species.

MALAYAN GENERA AND SPECIES

The Malayan Corixidæ are represented by the three genera, *Micronecta, Agraptocorixa* and *Tropocorixa. Micronecta* is the commonest and seven species have been recorded, one of which is new. The other two genera are represented by one species each. The following key is given for the separation of the genera:

1. Scutellum exposed, covered by pronotum only at anterior margin; antennæ three-jointed; rarely exceed 4.5 mm. in length .... *Micronecta*

–. Scutellum covered by pronotum (apex may be visible); antennæ four-jointed; rarely less than 4.5 mm. in length 2

2. Pronotum and elytra unicolorous hyaline; fore leg of male without a well defined stridulatory area .... *Agraptocorixa*

–. Pronotum and elytra with dark brown vermiculate markings; fore leg of male with well defined stridulatory area .... *Tropocorixa*

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[1] Part of a thesis accepted by the University of Singapore for a M.Sc. Degree.

TAXONOMY

The characters used in the taxonomy of the Corixidæ have been revised in detail by Hungerford (1948). As Wroblewski (1958) has pointed out, the male parameres, in spite of their variation, are the only reliable characters for species identification. These have been used by most recent workers on South East Asian species.

Micronecta

Micronecta is found throughout the Eastern and Western Hemispheres. It is differentiated from the closely related genus restricted to the Western Hemisphere namely *Tenagobia* by the crescent-shaped pronotum and the absence of a strigil in the males of the latter. Important contributions to the study of the genus in this part of the world include those of Lundblad (1933), Hutchinson (1940) Chen (1960) and Wroblewski (1960).

Micronecta issa (Dist.)

Material examined.—Malaya: Johore, Kahang, 26-27-11-1961, 1 male, 28 females; 13-12-1961, 3 females; 14-12-1961, 17 females; 15-12-1961, 2 males, 8 females; 23-12-1961, 7 females; 24-12-1961, 17 females; 25-12-1961, 6 females; 28-12-1961, 4 females; 10 mi, Mawai Road, 5-5-1960, 1 male, 1 female.

The male measures 2.92-2.96 × 1.33[2]; the female 2.23-2.52 × 1.10-1.35. The head is pale coloured with a dark brown posterior margin. Pronotum and hemelytra irregularly dotted; but in the case of the hemelytra the dots tend to merge into large blotches of brown. Abdomen and legs yellow.

Lundblad (1933) described as *Synaptonecta breddini* what is now known to be the brachypterous form of *Micronecta issa,* the latter being based on the macropterous form (Hutchinson, 1940). *Micronecta issa* differs from all other species in that the male possesses a tibiotarsus formed from the fusion of the tibia and the tarsus of the anterior leg. Another distinctive feature is that the free lobe of the eighth abdominal tergite lacks a tuft of hairs at its distal end.

In the brachypterous form, the hemelytra is peculiarly shaped, though the colour pattern is very much the same as the macropterous form. The hind wing is poorly developed. Unlike the macropterous form, the pronotum is very much shorter than the head, being only about half the head length. The pronotal width is slightly over six times its length; and the lateral margins are short and indistinctive.

Micronecta issa has so far been found in only two habitats in Malaya. Judging from the yield and frequency of occurance in light-trap catches, it is probably a common species in Malaya. The species is also recorded from Burma, India and Java.

Micronecta thyesta Dist.

Material examined.—Malaya: Malacca, Jasin Stream, 1 female; Johore, Mawai-Sedili Road, 10-11-1960, 2 females; 6 mi, Mawai-Sedili Road, 20-10-1960, 1 female; 21-8-1960, 1 female; Kahang, 14-12-1961, 1 male.

The male measures 3.09 x 1.40; the female 2.95 x 1.40. The head is pale coloured with brown posterior margin. Pronotum and scutellum brown. Hemelytral pattern in the form of dark, uneven, broken stripes. Venter and legs stramineous.

Micronecta thyesta is the second largest of the Malayan species, and can be distinguished from all the others in that it lacks a strigil.

Micronecta thyesta has been found to occur at a temporary habitat in Johdre. Fernando (1963*c*) has recorded it at light. The species is also recorded from India, Taiwan and Ceylon.

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2 All measurements in millimetres.

Micronecta punctata Fieb.

Material examined.—Malaya: Negri Sembilan, Rembau, 31-10-1961, 9 males, 22 females, nymphs; Johore, Kahang, 26–27-11-1961, 2 males, 47 females; 14-12-1961, 2 males, 75 females; 15-12-1961, 3 males, 102 females; 13-12-1961, 18 females; 16–17-11-1960, 5 males, 33 females; 28-12-1961, 11 females, 25-12-1961, 1 male, 6 females; 24-12-1961, 16 females; 23-12-1961, 12 females; Sedili Kechil, 2-3-1960, 7 males, 12 females, nymphs; Malacca, Jasin, 4-4-1960, 2 males, 2 females, nymphs; Masjid Tanah Road, 5-3-1960, 3 males, 3 females, nymphs; Penang, Sungei Burong, 28-10-1961, 5 males, 11 females, nymphs; Penang Hill, 24-10-1960, 1 female; Selangor, 23 mi, Sabak Bernam, 16-3-1960, 2 females; Singapore: 17 mi. Jurong Road, 29-6-1961, 1 male, 2 females; Buona Vista Road, 2-10-1961, 1 male; Plantation Road, 13-3-1962, 2 males, 2 females, nymphs.

The male measures 2.57-2.72 x 1.15-1.30; the female 2.47-2.87 x 1.29-1.40. The head is pale coloured. Pronotum greyish-brown with brown margins; and a broken brown stripe centrally across the disc. Scutellum brown. Hemelytra has a pale background with irregularly arranged black spots. Venter and legs yellow.

Micronecta punctata is easily recognised by its hemelytral patterning. Both the brachypterous and macropterous forms exist locally. They can be distinguished by the fact that in the brachypterous form the length of the head is much greater than the pronotal length; whilst in the macropterous form the head and pronotal length are about equal.

Micronecta punctata has been found to occur in sawahs (temporary habitats). Fernando (1959) has recorded it from rock pools in Ceylon. In Malaya, it is the most common species next to *Micronecta quadristrigata*. Fernando (1963*c*) has recorded it at light in Malaya. Also recorded from Ceylon, Java, India, Sumatra and Siam.

Micronecta scutellaris (Stal.)

Material examined.—Malaya: Johore, Kahang, 28–29-11-1960, 1 male, 3 females; Malacca, Batu Berendam, 3-10-1960, 1 female; Singapore: Lorong Chuan, 29-8-1961, 3 males, 7 females; 4-9-1961, 13 males, 28 females; 10 mi, Tampenis Road, 9-4-1962, 1 male, 1 female.

The male measures 3.68-4.10 x 1.52-1.64; the female 3.71-4.35 x 1.55-1.76. Head pale coloured. Pronotum dull grey with a broken brown stripe across the disc a third of the way from the posterior margin. Scutellum dark brown. Hemelytra grey with broken brown longitudinal stripes. Venter and legs yellow.

Micronecta scutellaris is easily recognised as the largest Malayan species with a length exceeding 3.5 mm.

Micronecta scutellaris has often been found to occur together with *Micronecta quadristrigata*, but is by no means as common or abundant as the latter. Both species are among the most widely distributed aquatic Hemiptera in South-east Asia, (Fernando, 1963*a*). *Micronecta scutellaris* has been recorded at light and in temporary habitats (Fernando, 1961*a* & 1963*b*). Also recorded from Africa, Arabia, Burma, Ceylon, India and Palestine.

Micronecta quadristrigata Bredd.

Material examined.—Malaya: Johore, Kahang, 15-12-1961, 43 males, 57 females; 28–29-11-1960, 36 males, 47 females; 13-12-1961, 33 males, 67 females; 16–17-11-1960, 18 males, 82 females; 18-9-1960, 14 males, 18 females, nymphs; 30-10-1960, 2 males, 15 females; 29-4-1961, 3 males, 3 females; 25-12-1961, 61 males, 39 females; 14-12-1961, 53 males, 47 females; 24-12-1961, 55 males, 45 females; 23-12-1961, 33 males, 67 females; 28-12-1961, 50 males, 50 females; 4 mi. Mawai-Sedili Road, 10-11-1960, 2 females; Mt. Ophir, 4-4-1960, 1 male, 2 females, nymphs; Malacca, Batu Barendam, 3-10-1960, 40 males, 60 females; Bukit Sabukor Road, 6-4-1960, 8 males, 11 females; ½ m. Alor Gajah, 8-4-1960, 2 males; Perak, Taiping, 15 m. Kuala Kangsar Road, 24-10-1961, 21 males, 31 females; Penang, Glugor, 24-10-1961, 2 females; Pulau Betong, 28-10-1961, 13 males, 27 females, nymphs; Penang Hill, 24-10-1960, 32 males, 68 females; 23-10-1960, 43 males, 57 females; Selangor, Sabak Bernam, 16-3-1960, 38 males, 62 females; Singapore: 17 mi. Jurong Road, 30-6-1961, 1 male; Changi, Pond, 19-12-1960, 1 female; Lorong Chuan,

4-9-1961, 34 males, 66 females, nymphs; 2-10-1961, 13 males, 32 females, nymphs; 8-8-1961, 2 females; 29-8-1961, 50 males, 50 females; Buona Vista Road, 2-10-1961, 2 females; 12¾ mi. Tampenis Road, 15-8-1961, 1 male, 1 female; 10 mi. Tampenis Road, 9-4-1962, 2 males; Boon Lay Road, 27-3-1962, 2 males, 17 females, nymphs.

The male measures 2.47-3.14 x 1.10-1.12; the female 3.24-3.38 x 1.31-1.37. Head pale coloured with brown posterior margin. Pronotum grey with a broken brown stripe across the posterior third of the disc. Scutellum dark brown. Hemelytra grey with longitudinal, broken brown stripes. Venter and legs yellow.

This is the commonest Malayan species of *Micronecta*. Superficially it resembles *Micronecta thyesta;* however, the very distict shape of the free lobe of the eighth tergite in *Micronecta quadristrigata* easily distinguishes the two.

Micronecta quadristrigata occurs commonly in sawahs in Ceylon (Fernando, 1959), Indonesia (Ardiwinata, 1958) and Malaya. Lundblad (1933) collected this species from a large variety of habitats including lakes, sphagnum pools, fountains and hot springs. It usually forms the bulk of the light-trap catches in Malaya (Fernando, 1961*a*, 1963*c*). It has also been recorded at light in Indonesia (Lundblad, 1933), Ceylon (Fernando, 1961*b*), and India (Fernando, in press). Also recorded from Ceylon, India, Java, Philippine Islands and Sumatra.

Micronecta albifrons (Motsch.).

Material examined.—Malaya: Johore, Kahang, 26–27-11-1961, 1 male, 10 females; 15-12-1961, 3 males, 2 females; 14-12-1961, 3 males, 3 females; 3-12-1961, 2 males, 5 females; 24-12-1961, 4 males, 3 females; 25-12-1961, 1 male, 1 female; 23-12-1961, 3 males, 1 female; Malacca, Jasin, 4-4-1960, 4 males, 1 female; Singapore: Buona Vista Road, 5-7-1961, 19 males, 22 females, nymphs; 13½ mi. Sembawang Road, 21-1-1960, 8 males, 21 females; nymphs; Changi, Pond, 19-2-1960, 5 females; 12¾ mi. Tampenis Road, 15-8-1961, 2 females; Ang Mo Kio, 13-3-1962, 2 males, 1 female; Lorong Chuan, 29-8-1961, 1 male, 9 females.

The male measures 2.08-2.28 x 0.89-0.93; the female 2.13-2.29 x 0.87-0.93. Head pale coloured. Pronotum light brown with two short transverse stripes not reaching the lateral edges of the pronotum. Both the anterior stripe (central in position) and the posterior stripe (close to posterior margin of pronotum) are discontinuous and dark brown in colour. Scutellum light brown. Hemelytra light brown with well defined brown stripes on the clavus and corium. Venter and legs yellow.

Chen (1960) has clarified the position of Hutchinson's sub-species *Micronecta albifrons albifrons* (Motsch.) and his intermediate race *M. albifrons albiforns* trans. ad. *striatella* Lundb. as being the brachypterous and macropterous forms respectively. Both forms are present in Malaya. The macropterous form has a longer pronotum, the median length being one third the pronotal width.

Micronecta albifrons has been recorded in temporary habitats in Ceylon (Fernando, 1959) but not in Malaya. Locally, it is present in light catches quite frequently but not in abundance. Fernando (1963*c*) has recorded it at light in Kahang, Johore, and in Ceylon (Fernando, 1961*b*). Also recorded from Burma, Ceylon, India and Java.

Micronecta malayana sp. nov.

Holotype.—A dissected male, 6th mile, Johore Bahru—Pontian Road, Johore, Malaya, collected by Dr. C. H. Fernando on 27th February, 1960, deposited in the British Museum (Natural History), London.

Paratypes.—(All with the same date as the holotype.) 2 males and 2 females, British Museum (Natural History); 2 males and 2 females, Institute of Zoology, Polish Academy of Science, Poznan, Poland; 1 male and 3 females, Zoology Department, University of Singapore.

Other material examined.—Malaya; Johore, 6 mi., Pontian Road, 27-2-1960, 14 males, 18 females, nymphs; Kahang, 13-12-1961, 1 female; 26-27-11-1961, 1 male, 1 female; 14-12-1961, 4 males, 5 females; 10 mi., Mawai Road, 5-5-1960, 3 males, 2 females; Selangor 7 mi., Banting-Klang Road, 17-3-1960, 6 males, 10 females, nymphs.

The males measure 2.04-2.30 x 0.88-0.96; the females 2.08-2.20 x 0.08-0.88. Head pale coloured. Pronotum yellow with brown markings in the form of two small rectangles centrally. In some specimens, each continues laterally as a short streak. Scutellum brown. Hemelytral pattern as reticulations of brown on a pale yellow background. Abdominal venter and legs yellow.

Structure.—The length of head to pronotum as 3: 2. Width of head almost three and one third its length. The least interocular distance about one and a half times the posterior margin of eye. Pronotal width nearly five times the length. Pronotum triangular in shape with short lateral margins. Proportions of median lengths of pronotum, scutellum, and distance from apex of scutellum to apex of clavus as 7: 8: 33. Hemelytra smooth and shiny with fine hairs. Margins of fifth to seventh abdominal segments as in figs. 1*a*–1*c*. Free lobe of the eighth tergite has an emarginate distal margin with a short tuft of hairs at one end. Strigil dextral. Parameres as in figs. 1*e* and 1*f*.

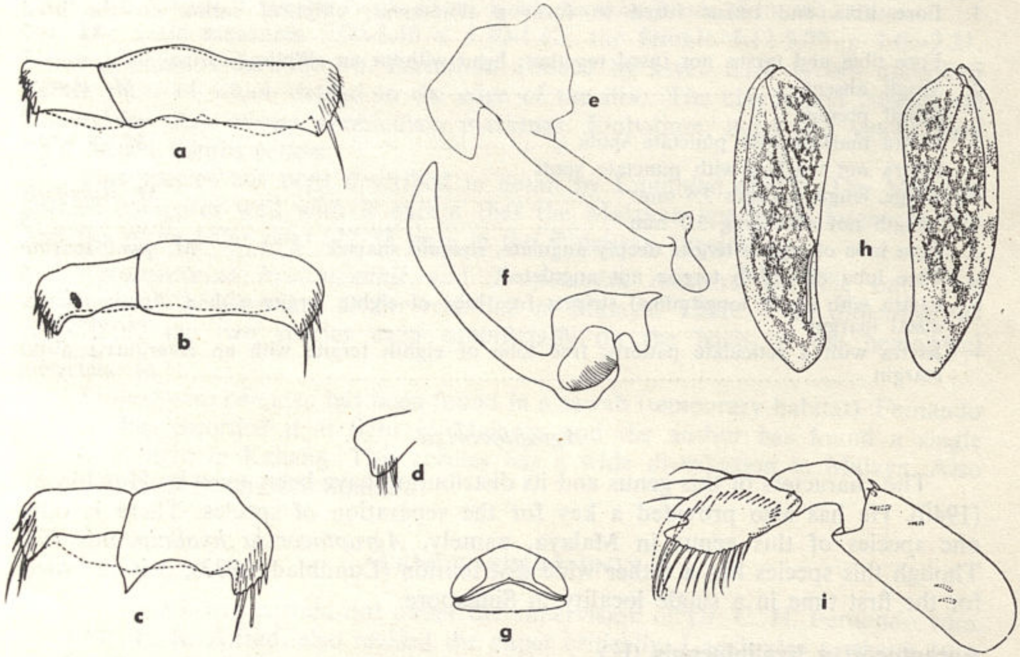

Figure 1. *Micronecta malayana* sp. nov. *a–c* fifth to seventh abdominal segments in ventral view, *d* free lobe of eighth tergite, *e* left paramere, *f* right paramere, *g* head and pronotum, *h* hemelytra, *i* foreleg of male.

Chætotaxy of anterior leg and shape of claw as in fig. 1*i*. Middle leg: femur: tibia: tarsus: claw as 100: 34: 45: 31. Hind leg: femur: tibia: $tarsus_1$: $tarsus_2$ as 100: 68: 86: 34.

Discussion.—*Micronecta malayana* sp. n. is very similar to *Micronecta ludibunda* Bredd. from Java (Lundlad, 1933). However, they may be distinguished by a number of characteristics. In *Micronecta malayana,* the pronotum is triangular-shaped due to very short lateral margins; the hemelytral pattern consists of reticulations both on the clavus and corium; and the free lobe of the eighth tergite has an emarginate distal margin. *Micronecta ludibunda* differs in having longer lateral pronotal margins; the hemelytral pattern consists of distinct stripes; and the free lobe of the eight tergite has an a'most straight distal margine. The most important difference lies in the shape of the left paramere in the two species. In both

cases the left paramere is made up of a small distal lobe attached to the main proximal portion. In *Micronecta malayana* this distal lobe narrows markedly at the region of attachment, whilst in *Micronecta ludibunda* the sides of the distal lobe are sub-parallel. In addition, the apex of the proximal portion in *Micronecta malayana* is pointed and directed upwards. *Micronecta ludibunda* however, has a truncate apex to its proximal portion.

Both the brachypterous and macropterous forms are present. The macropterous form has a longer pronotum and also longer lateral margins, so that it does not appear triangular-shaped.

Micronecta malayana has been recorded in light-trap catches from Kahang, Johore and from shallow pools with peaty bottom. It appears to be a common species.

KEY TO THE MALAYAN SPECIES OF MICRONECTA

1. Fore tibia and tarsus fused to form a tibiotarsus; elliptical carina on the head .... *M. issa*
–. Fore tibia and tarsus not fused together; head without an elliptical carina 2
2. Strigil absent .... *M. thyesta*
–. Strigil present 3
3. Elytra marked with punctate spots .... *M. punctata*
–. Elytra not marked with punctate spots 4
4. Large, length exceeds 3.5 mm. .... *M. scutellaris*
–. Length not exceeding 3.5 mm. 5
5. Free lobe of eighth tergite deeply angulate, sigmoid shaped .... *M. quadristrigata*
–. Free lobe of eighth tergite not angulate 6
6. Elytra with entire longitudinal stripes; free lobe of eighth tergite with a slightly convex distal margin .... *M. albifrons*
–. Elytra with a reticulate pattern; free lobe of eighth tergite with an emarginate distal margin .... *M. malayana*

Agraptocorixa

The characters of this genus and its distribution have been given by Hutchinson (1940). He has also provided a key for the separation of species. There is only one species of this genus in Malaya, namely, *Agraptocorixa hyalinipennis* (F). Though this species has a rather wide distribution (Lundblad, 1933), it is recorded for the first time in a single locality in Singapore.

Agraptocorixa hyalinipennis (F.).

Material examined.—Singapore: Lorong Chuan, 4-9-1961, 3 males, 9 females, nymphs; 8-11-1961, 3 females; 20-2-1962, 1 female.

The male measures 6.60-7.08 x 2.73-2.75; the female 7.50-8.45 x 2.88-3.10. General facies light or dark brown. Head, pronotum, and hemelytra light brown and hyaline. Markings absent except for two light patches near the posterior margin of the pronotum, and a darker patch near the inner basal angle of each clavus. The dark brown colour of the insect is due to the tergites which are visible through the transparent hemelytra. Abdominal venter and limbs light brown or yellow.

Agraptocorixa hyalinipennis (F.) is very similar to two other species, *Agraptocorixa sacra* Hutch. and *Agraptocorixa dakarica* Jacz. from Africa. Hutchinson (1940) has given in detail the differences between the three species based on the shape of the pronotum, the number of palar pegs, the size of the strigil, the margin of the seventh abdominal tergite and the shape of the left paramere.

This is the first record of the species in Malaya. Lundblad (1933) has included it among the second most widespread group of aquatic Hemiptera. In addition to his distribution data, it has been recorded in Ceylon by Mendis and Fernando (1962). Also recorded from Burma, Ceylon, Formosa, India, Indo-China, Java, New Guinea and Sumatra.

Tropocorixa

Hutchinson (1940) created this as a sub-genus. It has representatives in both Eastern and Western Hemispheres. There is only a single species of the sub-genus in Malaya, namely, *Tropocorixa connexa* (Lundb.). It is described here from the material available.

Tropocorixa connexa (Lundb.).

Material examined.—Malaya: Johore, Kahang, 13-12-1961, 1 female; Malacca, Alor Gajah, 8-4-1960, 11 males, 13 females, nymphs; Bukit Sabukor Road, 6-4-1960, 18 males, 16 females; 6½ mi. Kuala Pilah, 7-4-1960, 2 males, 2 females; Negri Sembilan, Rembau, 31-10-1961, 3 males, 1 female; Perak, 15 m., Kuala Kangsar Road, 24-10-1961, 1 female.

The male measures 5.00-5.48 x 1.70-1.82; the female 5.12-5.75 x 1.66-2.21. General facies is dark brown. Pronotum crossed by seven dark brown unbroken bands, most of which extend to the edge of the disc. The clavus and corium are covered by dark brown vermiculate markings. Embolium, head and venter very light brown. Limbs yellow.

This species has been described in detail by Lundblad (1933). The Malayan species compares well with it except that the Malayan species is larger in size and has more palar pegs (22-23 pegs in the Sumatran species).

Agraptocorixa hyalinipennis and *Tropocorixa connexa* are the only two members of the Corixinæ so far recorded in Malaya. There is no difficulty distinguishing the two species even superficially on the basis of the hemelytral pattern.

Tropocorixa connexa has been found in a sawah (temporary habitat). Fernando (1961*a*) has recorded it at light in Malacca and the author has found a single female at light in Kahang. This species has a wide distribution in Malaya. Also recorded from Burma and Sumatra.

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This work was carried out under the supervision of Dr. C. H. Fernando who, with Mr. E. R. Alfred, also revised the paper critically. I wish also to thank Miss L. C. Chen, Department of Entomology, University of Kansas, U.S.A. for her critical comments on the new species of *Micronecta*.

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BULLETIN OF THE NATIONAL MUSEUM SINGAPORE

No. 33 **January 31, 1967** **Part 13**

On *Acanthocephalus bufonis* (Shipley) a common parasite of Malayan amphibians

By P. H. YUEN *and* C. H. FERNANDO

Zoology Department, University of Singapore

(*Received, June 1963*)

INTRODUCTION

Although *Acanthocephalus bufonis* is a very common parasite in Malayan amphibians it has so far gone unrecorded. Described in 1903 by Shipley from Thailand it has subsequently been reported from Hong Kong (Southwell and Macfie, 1925), Indo-China (Joyeux and Baer, 1935), China (Van Cleave, 1937) and the Celebes (Yamaguti, 1953). In the present paper it is redescribed from abundant material collected in Malaya. It has been recorded from both bufonid and ranid hosts previously.

HOST LIST

In Malaya it has been found in a wide variety of hosts collected from many localities. These are listed below.

Host[1]	Locality
Rana cancrivora	Kuala Lumpur, Selangor; Thomson Road, Singapore.
Rana chalconta	24th mile Gombak Road, Pahang.
Rana erythraea	Ampang, Selangor.
Rana macrodon	Templer Park, Selangor; 24th mile Gombak Road and Genting Simpah, Pahang; Singapore.
Rana tigrina rugulosa	Selayang, Selangor.
Bufo asper	Genting Simpah, Pahang; Kuala Lumpur, Selangor.
Bufo melanostictus	Botanic Gardens, Penang; Kuala Lumpur, Selangor; Singapore.
Kaloula pulcra	Kuala Lumpur, Selangor.

The distribution in hosts and localities is almost certainly very wide.

Acanthocephalus bufonis occurs in very large numbers in *Bufo melanostictus*. Sometimes the whole intestine is chocked with them. In the other hosts the infection rate is much lower. The widespread nature of this acanthocephalan is probably due to its having a large number of intermediate host species.

1. The naming of hosts is according to Smith (1930).

In addition to Malayan material, specimens were collected by one of the authors (C.H.F.) from Colombo, Ceylon and Calcutta, India. It appears that *Acanthocephalus bufonis* is widespread from India to China and extends southwards to the Celebes. Golvan (1959) however gives its distribution as the Far East.

DESCRIPTION

The size of the mature individuals is very variable. They measure about 5–20[2] long and 1–2 in breadth. The proboscis (fig. 1b) is subcylindrical, measuring $0.39–0.49 \times 0.20–0.37$ in the male and $0.44–0.56 \times 0.28–0.41$ in the female. The proboscis hooks (fig. 1c) are arranged in 19–20 longitudinal rows of 5–6 each. The hooks measure 0.068–0.14 in length. The neck is 0.14–0.16 long. The proboscis receptacle measures $0.46–0.58 \times 0.21–0.34$ in the male and $0.48–0.74 \times 0.24–0.38$ in the female. The elliptical ganglion is situated near the posterior end of the receptacle. The lemnisci are $0.67–1.28 \times 0.086–0.26$. The trunk measures $6.5–9.0 \times 0.93–1.29$ in the male and $11.0–19.0 \times 1.09–2.00$ in the female. The testes are oval, $0.56–0.84 \times 0.36–0.61$ and lie tandem in the middle third of the body trunk. The cement glands are long and slender and extend to the posterior end of the testis. The uterus, vaginal sphincter, and vaginal bulb measure 0.67–0.79, 0.056–0.064 and 0.031–0.037 respectively. In the living condition the outer and inner shells of the egg and the embryos measure $0.082–0.089 \times 0.026–0.029$, $0.062–0.069 \times 0.021–0.023$ and $0.054–0.056 \times 0.018–0.020$ respectively.

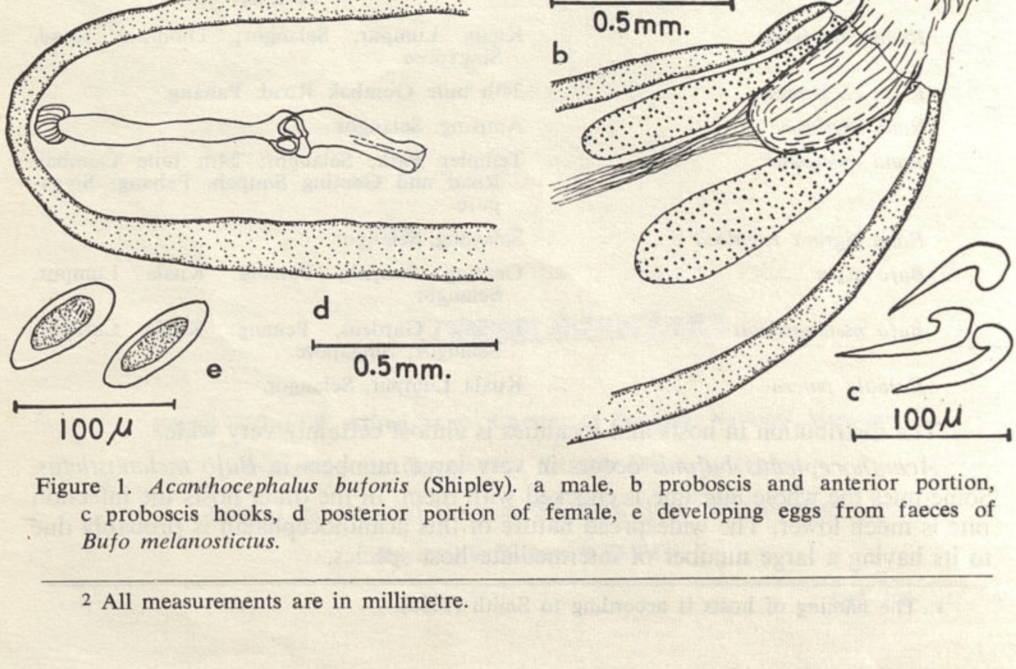

Figure 1. *Acanthocephalus bufonis* (Shipley). a male, b proboscis and anterior portion, c proboscis hooks, d posterior portion of female, e developing eggs from faeces of *Bufo melanostictus*.

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[2] All measurements are in millimetre.

DISCUSSION

Acanthocephalus bufonis has been recorded from *Bufo melanostictus* and *B. penangensis* from Patani, Thailand (Shipley, 1903), *Rana nigromaculata* and *R. formosus* in China (Van Cleave, 1937), and Rana tigrina and *Bufo asper* in Celebes (Yamaguti, 1953). The Malayan material shows slight differences to the previous descriptions of the species in egg size and in the diameter of the vaginal sphincter and vaginal bulb.

SUMMARY

Acanthocephalus bufonis is recorded for the first time in Malaya from eight species of amphibian hosts. It is described briefly with notes on distribution.

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COMPLIMENTARY

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BULLETIN OF THE NATIONAL MUSEUM SINGAPORE

No. 33 January 31, 1967 Part 14

New records of helminths from Malayan reptiles with a description of *Mesocoelium gonocephali* sp. nov.

By MULKIT SINGH

Zoology Department, University of Singapore

(*Received, July 1963*)

INTRODUCTION

Previous work on helminths of Malayan reptiles has been reviewed by Balasingam (1963) who added many new records and described one new species of trematode. In the present paper six additional helminths are recorded from Malayan reptiles, of which one is a new species.

Names of reptile hosts are those used by Smith (1930). The material examined was obtained from the helminthological collections of the Zoology Department and the Department of Parasitology, University of Singapore. Some of the material was also collected by the author. The trematodes and cestodes were firmly pressed and fixed in alcoholic Bouin. They were preserved in 70 per cent alcohol and stained in Delafield's Hæmatoxylin or Borax carmine. The nematodes were fixed in hot 70 per cent alcohol and later preserved in 70 per cent fresh alcohol. These were examined in lactophenol.

NEMATODA

Spiroxys gangetica Baylis and Lane

Three females and one male were collected from the stomach of a *Trionyx* sp., of which the gut alone was purchased from the Sago Lane Market, Singapore on 17th May, 1962. The host probably originated from Malaya. When alive the worms were semi-transparent.

S. ganetica resembles *S. torquata* Karve which was recorded by Baylis (1933) from the stomach of *Trionyx cartilageneus* in Malaya. This species was subsequently synonymised with *S. annulata* Baylis and Daubney, by Baylis (1939). *S. annulata* resembles *S. gangetica* in the following features: presence of a median tooth in each lobe of the lips, presence of caudal papillæ in the female, similar number and arrangement of caudal papillæ in the male, a forwardly directed vagina, and similar egg size. It however differs from *S. gangetica* mainly in having equal spicules and in general body measurements. *S. gubernæ* Chakravarty and Majumdar from an Indian tortoise *Chitra indica,* resembles *S. gangetica* in the following features: absence of median teeth in the middle lobe of the lips, absence of caudal papillæ in the female, presence of an accessory piece, and the proportions of the different parts of the body and size of eggs.

Cucullanus serratus (Lane)

Twenty females and six males were obtained from the small intestine of a *Trionyx* sp. The gut of the host was purchased from the Sago Lane Market, Singapore, on 17th May, 1962. The host probably originated from Malaya. Six males and three females were measured.

The genus *Cucullanus* Muller, 1777, has been reviewed by Tornquist (1931) and a number of new species were subsequently added by Yamaguti (1961). The present material agrees with the description of *C. serratus* given by Baylis (1939). The genus *Dichelyne* Jagerskiold, 1902, resembles *Cucullanus* closely and they were regarded as synonymous by Yorke and Maplestone (1926). *Dichelyne trionyxi* described by Chakravarty and Majumdar (1961) from *Trionyx gangeticus* resembles *C. serratus* in many respects. *D. trionyxi* however possesses a cæcum whereas *C. serratus* does not. This clearly separates the two genera.

Hastospiculum varani Skrjabin

The material examined came from the helminthological collection of the Zoology Department. It was collected on 24th March, 1961 from the mesentery of a monitor lizard, *Varanus salvator*.

The specimens described here have similarities to the two species, *Hastospiculum macrophallos* and *H. varani*. Baylis (1939) synonymised the two species and this view is accepted in the present work. Baylis (1939) also states that complete specimens are seldom obtained and that the males are comparatively rare. However this is not the case locally since we do have a number of males and all our specimens are complete.

Meterakis singaporensis (Sandosham)

The specimens were from the helminthological collection of the Zoology Department. They had been collected on 25th November, 1961 from a skink, *Mabuya multifasciata*, in Singapore. Four specimens were examined, of which only one was a male.

M. singaporensis has, so far, been described only from *Bufo melanostictus* and this is the first recorded instance of its occurrence in reptiles. The specimens described here are longer than those from *B. melanostictus*, and the distances of the excretory pore and nerve ring from the anterior end also differ slightly. However, the differences are slight compared to the many similarities. *M. singaporensis* resembles the two species *M. govindi* (Karve, 1930) and *M. mabuyæ*, (Chakravarty, 1944) but the spicule length in the specimens studied differs from that described in those species. In *M. govindi*, the spicules are only about 0.27 mm., and in *M. mabuyæ*, the spicules are only 0.3 mm. in length while in the present specimens the spicules are 0.972 mm. long.

TREMATODA

Mesocoelium gonocephali sp. nov. Figure 1

Holotype.—Collected from a *Gonocephalus grandis* in the Kepong Forest Reserve, Kuala Lumpur, Selangor, on 21st November, 1951, and deposited in the British Museum (Natural History).

Paratypes.—From the same host and locality, and deposited in the Zoology Department, University of Singapore, and British Museum (Natural History).

Description.—The body is elongate and is 2.04–3.28[1] long (type 3.28) and 0.75–0.94 in maximum width (type 0.94). It narrows down towards the posterior end. The cuticle is aspinous. The oral sucker is subterminal and measures 0.20–0.28 in diameter. The intestinal cæcæ extended to the midlevel region of the body. The acetabulum is almost as large as the oral sucker. It measures 0.22–0.24 in diameter. The sucker ratio is 0.99–1.16 : 1.

The testes are subspherical in shape and measure 0.11–0.17 × 0.09–0.14. They are much smaller than the ovary and are situated anterior to it. They are slightly posterior to the acetabulum and are situated on either side of it. The acetabulum partially overlaps them. The testes on the ovarian side is slightly anterior to its partner. They do not overlap the cæcæ. The cirrus pouch is oval and measures 0.098–0.144 × 0.047–0.072. The genital pore is in the midline posterior to the intestinal bifurcation.

The ovary is subspherical and measures 0.20–0.24 × 0.16–0.18 in size. It is posterior to the right testes. It does not overlap the acetabulum. The vitellaria are situated laterally in clumps in extracaecal position. They extend from the level of bifurcation in the pharyngeal region to a little posterior of the middle region of the body. The specimens contain a large number of eggs. The individual coils of the uterus are not seen. The eggs fill up the whole of the postovarian region. The egg size is 0.029–0.036 × 0.014–0.022. They vary in colour from yellow to black and are dimorphic in character.

Discussion.—Trematodes of the genus *Mesocœlium* Odhner, 1911, possess the following characteristics: spinous or aspinous, intestinal cæcæ of medium length, never reaching the posterior margin of the body, testes anterior to the ovary, vitellaria lateral to the cæcæ, intermingling along medial line but never extending to the posterior margin of the body, and excretory vesicle I– or J–shaped.

Members of this genus parasitise both amphibians and reptiles in which they are found in the small intestine.

Cheng (1960) reviews the genus *Mesocœlium* Odhner and recognizes only twenty-eight species, of thirty-two described species, as valid. The specimens described in this paper do not correspond to any of those reviewed by Cheng (1960). The present specimens bear resemblances to *Mesocœlium sociale*. *M. sociale* resembles *M. meggiti* very closely. Chatterji (1940) synonymised them as *M. sociale*. Cheng (1960) separates the two species on the basis of characters such as position of the genital pore and shape of excretory vesicle. He considers these two characters as sufficiently consistent to be reliable as diagnostic characters. Yuen (personal communication), however, has observed that the position of the genital pore is a variable character and that it may differ in living and preserved specimens. She has also mentioned that the shape of the excretory vesicle is difficult to distinguish in most cases. So, she feels that these characters cannot be used to separate *M. sociale* and *M. meggitti*. She shows that these are not consistent characters and agrees with Chatterji (1940) that the two species are synonymous in spite of the difference in the systematic position of the hosts.

The species described here differs from *M. sociale* in the following features: The cuticle is aspinous; the ventral sucker is larger, the sucker ratio being almost 1 : 1; the intestinal cæcæ do not reach the posterior one-third of the body; the testes are smaller and do not overlap the cæcæ; they are smaller than the ovary; and the vitellaria occur in clumps.

The name *Mesocœlium gonocephali* is proposed for this species after its host.

1. All measurements in mm. unless otherwise stated.

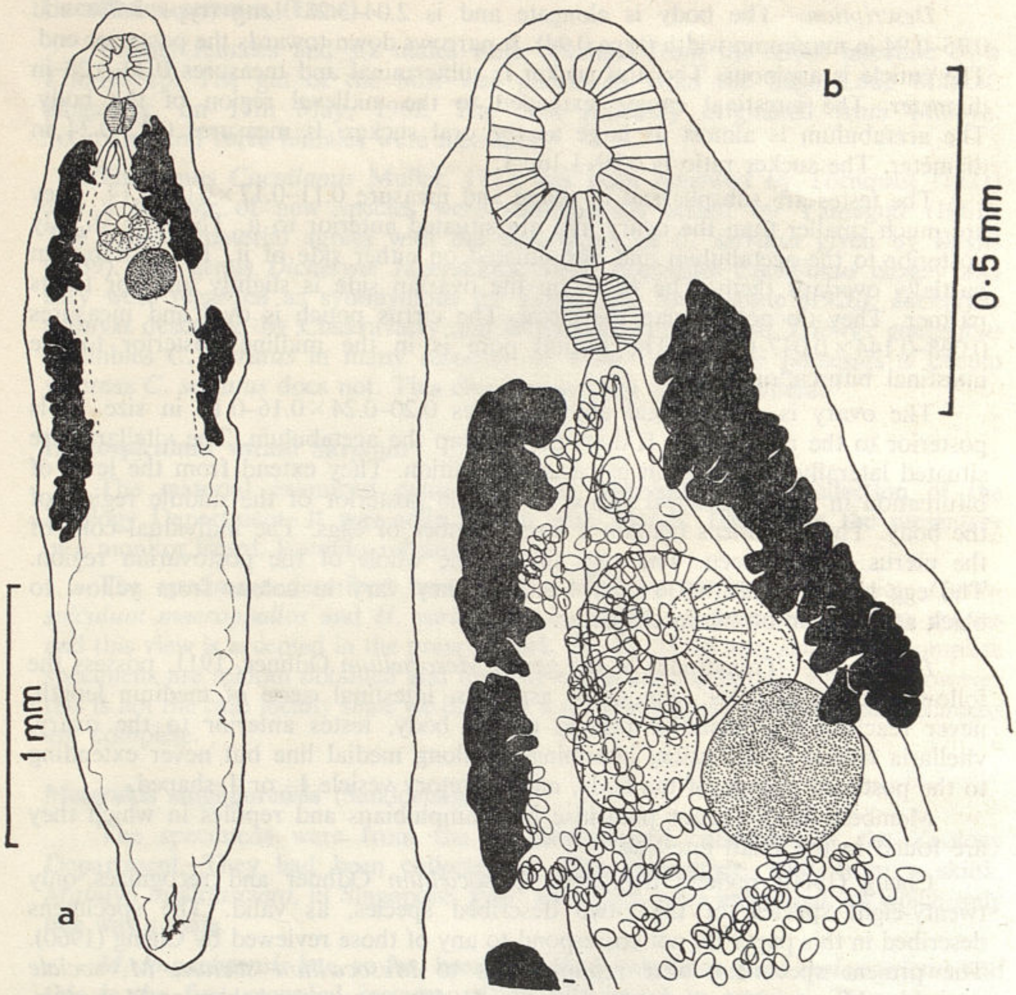

Figure 1. *Mesocoelium gonocephali* sp. nov. a ventral view, b anterior portion enlarged.

CESTODA

Acanthotaenia shipleyi von Linstow

The specimens were obtained from the helminthological collection in the Zoology Department. They had been collected from the small intestine of a *Varanus salvator* on 23rd March, 1961 in Malacca.

A. shipleyi von Linstow (1930) was first described from a *Varanus salvator* in Ceylon. Yamaguti (1954) re-described it from Celebes. Yamaguti's specimen differs from von Linstow's in the gravid proglottids being definitely longer than broad. He claims that von Linstow's specimen was immature and contracted so that the testis appeared crowded. In von Linstow's original description, the testis do not appear to be in two fields. He also failed to see the peripherally situated vitelline glands and wrongly termed the ovaries as vitelline glands. Yamaguti's specimens were better extended and the vitellaria and the two fields of testis were clearly noted.

The present specimens studied agree with Yamaguti's description. The worms on the whole are found to be longer and the proglottids narrower. This is probably due to the fact that they are well extended. The slight differences noted in many measurements are probably due to the state of contraction and extension of the worm when fixed in alcoholic Bouin. Beddard (1913) notes that the anterior end of *Acanthotænia* is very protrusible and the presence of a suckerlike depression at the anterior end depends on the state of protrusion of the anterior end.

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No. 33 February 28, 1967 Part 15

Berndtia nodosa sp. nov. (Cirripedia, Acrothoracica), a new burrowing barnacle from Singapore

By J. TOMLINSON

Biology Department, San Francisco State College

(*Received, February 1966*)

INTRODUCTION

Acrothoracican cirripeds burrow into almost anything calcareous, including corals. The genus *Berndtia,* previously known from the single species *B. purpurea* Utinomi, is noted for burrowing into coral which is living. The University of Singapore collection of the local coral *Psammocora contigua* (Esper) contained several dozen dried specimens of a new species of this genus. I obtained them through the courtesy of Dr. D. S. Johnson. The coral identification was confirmed by Prof. J. Wyatt Durham.

DESCRIPTION

Genus *Berndtia*

One pair of mouth cirri and 5 pairs of terminal cirri present; caudal appendage absent; optic nerve and well-developed eye may be present in adult. Type species, *B. purpurea* Utinomi (1950).

Berndtia nodosa sp. nov.

Female mantle apertural plates studded over their outer surfaces with numerous blunt, heavy, nodular teeth; margins of apertural lips bearing over 30 simple teeth; no well-developed conical body processes. Males adhere to female exuviæ of the attachment disk as well as the wall of the burrow.

Type material.—Holotype United States National Museum No. 113310. Paratypes at the National Museum of Singapore No. 1305; British Museum (Natural History); San Francisco State College; California Academy of Sciences; Seto Marine Biological Laboratory; and U.S. National Museum.

Holotype 3.04×1.5 mm. Average of 6 arbitrarily sampled females 2.88 mm. long, 1.44 mm. wide, and with an aperture 1.08 mm. long.

Female.—The mantle is composed of a typical bag-like covering of the body, with a narrow but heavy horny attachment disk representing cemented exuviæ where the animal is cemented to the burrow. The exterior of the mantle is studded with many fine teeth used in abrading the burrow in the coral. These may have from one to four points, unlike *B. purpurea*, which does not have four-pointed teeth. Around the aperture of the mantle these fine teeth are interspersed with small hairs and scale-like ridges common in the order. Muscle bands are conspicuous, particularly the longitudinal bands on the ventral lateral surface (fig. 1*a*).

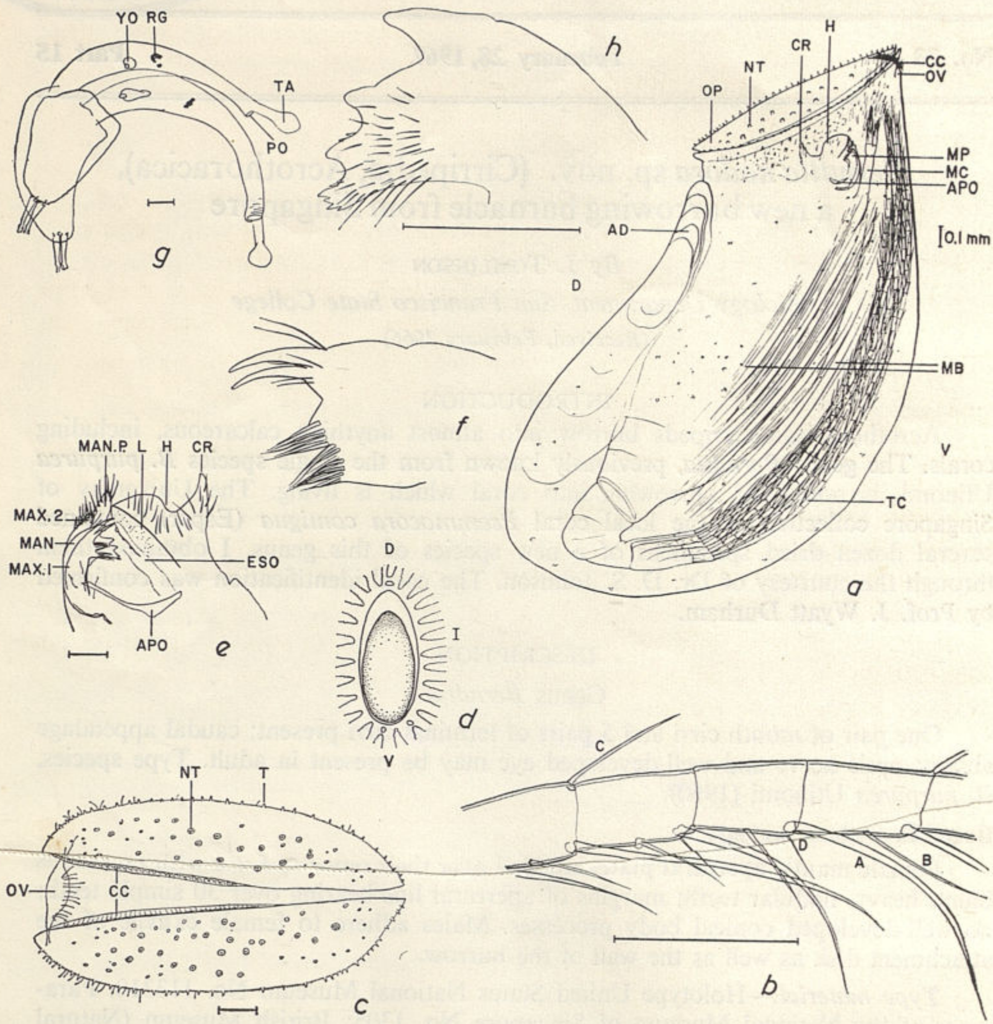

Figure 1. *Berndtia nodosa* sp. nov. *a* female, composite drawing of KOH-cleared specimens, *b* portion from middle of female sixth cirrus, setae A & B paired, C & D unpaired, *c* female operculum somewhat opened, showing nodular teeth in end-view, *d* burrow aperture of female in *P. contigua,* external vertical view (stippled area is interior of burrow, coral septal skeleton shown by wavy lines, clear area is accreted lip of burrow "shell"), *e* female head and mouthparts, *f* female first maxilla, *g* two males, *h* female mandible. AD = attachment disc, APO = apodeme, CC = comb collar, CR = crest, D = dorsal (rostral) sides, ESO = oesophagus, H = head, L = labrum, MAN = mandible, MAN. P = mandibular palp, MAX. 1, 2 = first, second maxilla, MB = mantle muscle bands, MC = mouth (first) cirrus, MP = mouth parts, NT = nodular tooth, OP = operculum, OV = orificial velum, PO = penis aperture, RG = reflecting granules, T = tooth, TA = terminal ampulla, TC = terminal cirrus, V = ventral (carinal) side, YO = yellow organ Scale 0.1 mm.

The aperture of the mantle bears two heavy plates or lips, analogous to the operculum of thoracican cirripeds, uniquely studded over the external surfaces with evenly-distributed heavy teeth which appear superficially blunt, but may have a very fine rosette of extremely small nodules around the outer margin.

The typical comb-collar on the inner ventral margins of the aperture extend into the "orificial velum" described by Utinomi in *Berndtia purpurea*, although the velum in this species does not appear to be as well developed as that in *B. purpurea*. The brush of fine hairs within the ventral apertural area of the mantle sac is found much as it is in *B. purpurea*.

No orificial knob is seen in this genus.

The coloration cannot be relied on in dried specimens, but it is suspected that the apertural areas may have been purplish colored, although not as prominently as other species of the order I have checked in the dried condition.

The mouth parts, consisting of the mandibles with palps and 2 pairs of maxillæ, are typical for the group. The palps and second maxillæ (not illustrated separately, see fig. 1*e*) are very similar to those of other species of the order.

The labrum, representing the anterior margin of the mouth field, is heavy, slightly rounded, and equipped with a few knobs of heavy chitin. Very fine dots are arranged in characteristic rows on the labrum, but their function is not known.

The head is rounded, sparsely set with small bristles not in distinguishable rows, and leads dorsally into a very pointed anteriorly-projecting conical "crest", but without the back-up fold or secondary crest shown in *B. purpurea*.

The mandible (fig. 1*h*) bears 3 major teeth, which diminish in size slightly toward the inner or inferior angle; the inferior angle bears a cluster of 4 or more teeth with subsidiary teeth on the sides. The 3 major teeth may also have smaller subsidiary teeth. Hairs set along the outer lateral surface do not appear to be as heavy as in *B. purpurea*.

The first maxilla (fig. 1*f*) has 2 major teeth on the upper or superior angle, a conspicuous notch without teeth or hairs, and an area of heavy bristles or fine teeth often divided into 2 distinct clumps or tufts along the inner or inferior edge. The auxiliary hairs along the lateral surfaces again do not appear as heavy as in *B. purpurea*. The apodemes are typical, with a heavy keel for muscle attachment.

Segmentation of the mouth cirri tends to be so obscure or vestigial that no attempt will be made to describe it. This segmentation is subject to variation in other species where it can be counted with some confidence, so I tend to discount the value of the characteristic at best. The anterior ramus is longer than the posterior ramus, and both are set on a pedicle with a short distal segment and a long proximal segment, the latter being slightly indented near the base, suggesting a possible further articulation.

There are 5 pairs of biramous, multi-segmented terminal cirri. The lesser curvature of each segment supports a distal pair of long setæ and a central, shorter pair. In addition, a very short unpaired bristle extends from between the bases of the distal pair. The distal end of every second to sixth segment along the greater curvature supports a single setæ. None of these bristles are plumose. The pedicles are 2-segmented, with the proximal segment not quite 3 times as long as the distal segment. The pedicle of the 1st pair of terminal cirri (cirrus 2) tends to be about one-third as thick as those of the other cirri, but may be over twice as wide.

The cirral segment count of the terminal cirri seems to be much more differentiating than the count of the segments of the mouth cirri. The count of a specimen of *Berndtia nodosa*, as compared with *B. purpurea*, is given in table 1.

TABLE 1
Cirral segment count of the two species of *Berndtia*

	B. purpurea					*B. nodosa*				
Cirrus number	2	3	4	5	6	2	3	4	5	6
Segment count:										
Anterior ramus	26	36	47	56	59	16	19	29	32	33
Posterior ramus	16	46	56	57	61	19	20	31	33	30
Length (mm.):										
Anterior ramus	3.45	4.1	5.35	5.55	5.65	1.3	1.8	2.5	2.65	2.65
Posterior ramus	2.5	4.65	5.65	5.63	5.68	—	—	—	—	—

The body segmentation is similar to *B. purpurea*, but no conical body processes have been seen.

Male.—The dwarf male resembles those of *B. purpurea* insofar as can be ascertained from dried specimens (fig. 1*g*). They are found primarily on the exuviæ of the female, and come out of the burrow with the female when the coral is decalcified. This is opposed to *B. purpurea*, where the males are invariably found attached to the wall of the burrow. *B. nodosa* males have been found singly (three times on the female) and in sets of two (once on the female, once on the burrow wall).

The shape of the male in this genus is unique in the order. It is considerably elongated, tadpole-shaped, and bears a terminal ampulla of unknown function at the posterior end. There appears to be a penis and the common "yellow organ" present. In addition, a scattering of opaque, reflecting, reddish-purple granules are found near the middle of the elongated body. These could be remnants of eye pigment, although no direct evidence is available.

Burrow.—The burrow is deeper than long in mature specimens. The aperture, viewed from outside, looks much like a typed apostrophe: a slit tapered slightly at the attachment end (fig. 1*d*). The average dimensions of this external aperture, for ten specimens arbitrarily circled on a piece of coral, is 1.1 × 0.5 mm. There might be a reaction to the burrowing action on the part of the coral, because a white shell of calcareous material surrounds the burrow, becoming especially prominent around the external aperture. Perhaps this is a product of the abrading action of the barnacle, forming fine granules which accrete and fill in the interstices of the coral's skeleton.

Two burrows without acrothoracican specimens were discovered on the dead arms of *Acropora tubicinaria* (Dana) from Pulau Kapas, Trengganu, Malaya, from the collection of the National Museum of Singapore, through the courtesy of Mr. Eric R. Alfred. They measured 1.2 × 0.39 mm. in apertural length and width of the undamaged specimen, and 1.4 × 0.39 mm. in the slightly broken specimen. The shape of the aperture was similar to that of *B. nodosa*, but inasmuch as penetration was made through algæ on the dead coral, the details of the calcareous shell was not apparent.

Many empty burrows were found on the under (dead) side of *Montipora efflorescens* in the collection of the University of Singapore. Measurements of three representative burrow apertures are 2.0×0.70, 1.2×0.39, and 0.85×0.31 mm., with an average of 1.35×0.47 mm. in length and breadth. One could hardly discern which end was more pointed, a trait common in *Berndtia.*

These two sets of burrows could have been made by *Berndtia nodosa,* judging from their size and shape, but they were definitely in the dead coral area, whereas the recovered specimens were apparently in living coral. Another set of burrows in the dead areas of *Favia speciosa* (Dana) from Pulau Kapas, Trengganu, Malaya, from the collection of the National Museum of Singapore, were much thinner and definitely pointed, measuring 0.81×0.15 mm. These empty burrows were probably not made by *Berndtia.*

An acrothoracican in the Fungiid coral *Podabacia crustacea* (Pallas) from Singapore, is illustrated in Plate 67, fig. 1, by Ma (1937). The under surface of the colony is heavily infested, probably by *Berndtia,* as suggested by Utinomi (1957), but more likely by *B. nodosa* than his *B. purpurea.*

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A new species of *Sesarma* from Singapore

By R. SERENE

and

C. L. SOH

(*Received, December 1966*)

INTRODUCTION

Whilst revising the named collection of *Sesarma* (Crustacea, Decapoda) maintained in the National Museum, Singapore, many additional specimens have been collected in Singapore. A new species is now described from specimens which cannot be identified with any other described species.

Sesarma (Sesarma) chentongensis sp. nov.

Holotype.—National Museum, Singapore, No. 1967.1.6.1, Johore Straits, 5–10 feet above sea level, collected by C. L. Soh, 13 February, 1966, a male of 35 × 37 mm.

Paratypes.—NMS. 1967.1.6.2, Sungei Malayu, Singapore, male (abdomen abnormal), 50 × 51 mm.; NMS. 1967.1.6.6, Sungei Berih, Singapore, male, 36 × 38 mm.; NMS. 1967.1.6.3–5, Sungei Melayu, Singapore, 2 females, 34 × 37 mm. & 33 × 35 mm., male, 36 × 38 mm.; NMS. 1967.1.6.7, Simpang Mak Wai, Singapore, male, 41 × 43 mm.

Description.—The species belongs to the *mederi* group, which includes 5 species: *mederi, versicolor, singaporensis, palawanensis* and *lafondi*. It differs from all of them by the following characters:—

(i) The number of tubercles of the cheliped dactylus range from 64–76, the tubercles being all relatively the same size. On all the other species the number of tubercles is always less than 60. The sole exception is *lafondi,* which has 89–90 on the male. However on the female of *chentongensis* the tubercles are as on the male; on *lafondi* the female has no tubercles but a continuous rim like a longitudinal keel with some scarce, light, transverse striae.

(ii) The different shape of the first male pleopod; the laminar chitinuous process situated on the apex is thin and with one lateral border broadened antero-laterally to produce a very sharp pointed corner.

The new species is closer to *singaporensis* and *mederi* than to *versicolor* and *palawanensis*. Like the first two species, it has the orbits relatively narrower than in the two other species, the breadth of the orbits on *chentongensis* being less than half the breadth of front. The shapes of the male chelipeds and abdomen of *chentongensis* are also more similar to those of *singaporensis* and *mederi*. The transverse crest on the inner face of the palm is so similar in the three species but the crest is a little more high on *mederi* and on *chentongensis*. There are on

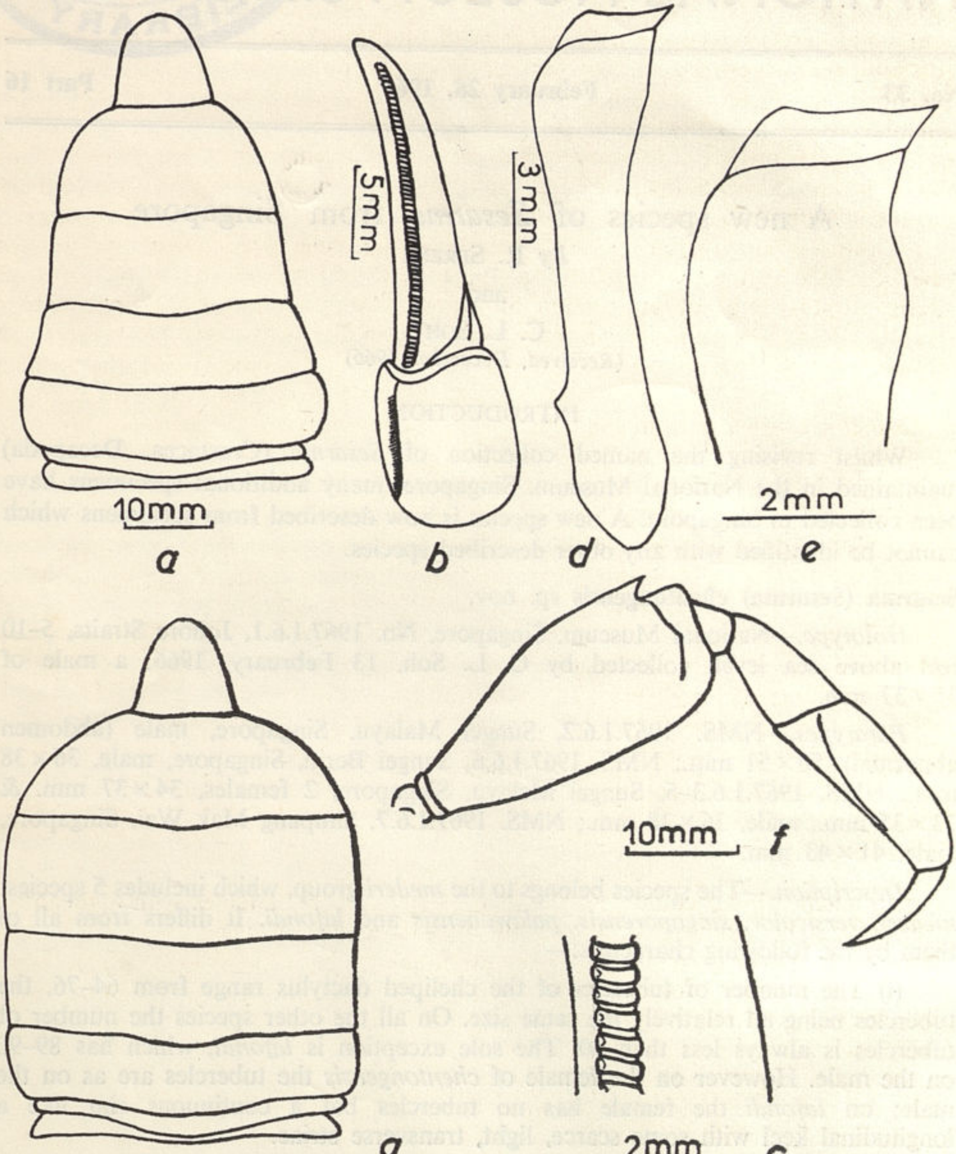

Figure 1. *Sesarma* (*Sesarma*) *chentongensis*, Holotype, *a* abdomen; *b* cheliped, dorsal view of palm and dactylus; *c*, shape of the tubercles of the dactylus; *d*, *e*, pleopod 1; *f*, right pereopod 4; *g* abnormal abdomen of a Paratype, NMS. 1967.1.6.2.

chentongensis below the lower end of the crest, some (5–6) accessory isolated granules which do not exist on the other species.

The new species is more clearly separated by the structure of its male pleopod, which differs in its apex from those of *mederi* and *singaporensis*. The lamellar chitinuous process occupies all the breadth of the tip and its lateral border ends distally in an acute angle. The general colour is like that of *mederi*, but on the cheliped, the outer face of the palm and dactylus are entirely deep red; on *mederi* the dactylus is always whitish.

The new species is very common in Singapore. Being very close to *mederi* and living in the same biotope, we think that specimens of *chentongensis* are probably included with those previously identified by authors as *mederi* or *taeniolata*.

Tweedie (1936) counts 44–45 tubercles on the male specimens of *mederi*, from Batavia, studied by Tesch (1917), but "rather over 60 . . ., 63 and 65 in the largest male" of his own collection from Singapore. We believe that the specimens of Tesch (1917) belong to *mederi*, but those mentioned with over 60 tubercles by Tweedie (1936) belong to *chentongensis*. Referring to Tweedie (1936), the tympana on the 4th sternite are "quite distinct" on the males from Batavia (= *mederi*) and "distinctly visible" only in the largest male from Singapore (= *chentongensis*).

TABLE 1

Measurements of male abdominal segment 6 in *S. chentongensis and S. mederi*

	Catalogue Number	Carapace Size	Abdominal Segment 6		
			Length	Breadth	Ratio
chentongensis	1967.1.6.7	41 × 43	8	15	1.92
	1967.1.6.2	50 × 51	8	20	2.50
	1967.1.6.1	35 × 37	7	13	1.85
mederi	1967.2.1.1	34 × 37	7	13	1.85
	1967.2.1.2	36 × 38	7	13	1.85
	1967.2.1.3	37 × 39	7	14	1.86

Tweedie (1940) counts 50–55 tubercles on a series of males with a breadth of 35–40; but he indicates 62–64 on the type specimen of *taeniolata*, which has a breadth of 45. In all other specimens examined by him, Tweedie (1940) notes that the number never exceeds 55. It is possible that *chentongensis* could be further established as identical with the type of *taeniolata*, which should be a distinct species and not a synonym of *mederi;* the male pleopod of the type specimen of *taeniolata* which is in the British Museum has to be checked. In any way, if these further observations demonstrate *chentongensis* as identical with the type specimen of *taeniolata*, and the two species as synonyms, that would not bring any change in nomenclature, since *taeniolata* White 1847 is a nomen nudum. As we stated before, *chentongensis* is clearly distinct from all other species by its male pleopod and the number of the tubercles on the cheliped dactylus. Other differing characters could also be given as the shape of the dactylar tubercles and the coloration of the palm. The comparison of the meri of pereopod 4 on *chentongensis* and *mederi* shows that it is a little less wider on *chentongensis* than on *mederi*. But we are inclined to use that character to separate species of the *mederi* group with reservations since, having examined large series of specimens, we found in each species some variation in that character. The ratio of the length to breadth of the male abdominal segment 6 of *chentongensis* is similar to that of *mederi*. One specimen (NMS) of

50 × 51 has an abnormal abdomen more wide than any other. As it is the largest specimen of our series, in which the size rarely exceeds 40, the abnormality is perhaps related to the large size, but probably not, because it shows a tendency towards the shape of the female. In any case the specific value of the ratio of length to breadth on abdominal segment 6 has to be considered always in close connection with the size of the specimens. We give measurements (Table 1) of the male abdominal segment 6 in some specimens.

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